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(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

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(72)Inventor : KOJIMA TOMOKAZU

NISHI KAZUYOSHI

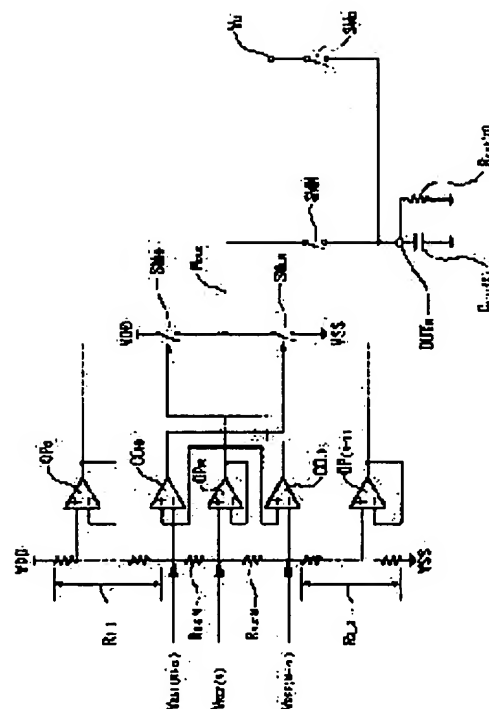
NAKAJIMA KO

(54) LIQUID CRYSTAL DISPLAY DRIVER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a liquid crystal display driver in which low power consumption, high speed operations and stability providing a hardly any oscillating condition are simultaneously satisfied.

SOLUTION: Voltages VREF0 to VREF(N-1), which are obtained by resistively voltage dividing the potential between a power supply voltage VDD and a ground potential VSS, are impedance converted by operational amplifiers OP0 to OP(N-1). A switch SWHM is added between the voltage VDD and the output of the operational amplifier OPM. A switch SWLM is added between the potential VSS and the amplifier OPM. The switches SWHM and SWLM are switched by the output signals of comparators COHM and COLM which monitor the output voltages of the operational amplifiers. When the switch SW0 is switched to the switch SWM, a high speed operation is conducted using the electric supply from the potential VDD or the potential VSS for a sudden change in the output voltage of the amplifier OPM. When the output voltage of the amplifier OPM is not changed (i.e., the switches SW0 and SWM are not switched), the operations are limited to the amplifier OPM only and therefore, the power consumption is similar to a conventional case and a stable condition for oscillation is realized.



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(21)出願番号	特願2002-151654(P2002-151654)	(71)出願人	000005821 松下電器産業株式会社 大阪府門真市大字門真1006番地
(22)出願日	平成14年5月27日(2002.5.27)	(72)発明者	小島 友和 大阪府門真市大字門真1006番地 松下システムテクノ株式会社内
		(72)発明者	西 和義 大阪府門真市大字門真1006番地 松下電器産業株式会社内
		(74)代理人	100068087 弁理士 森本 義弘

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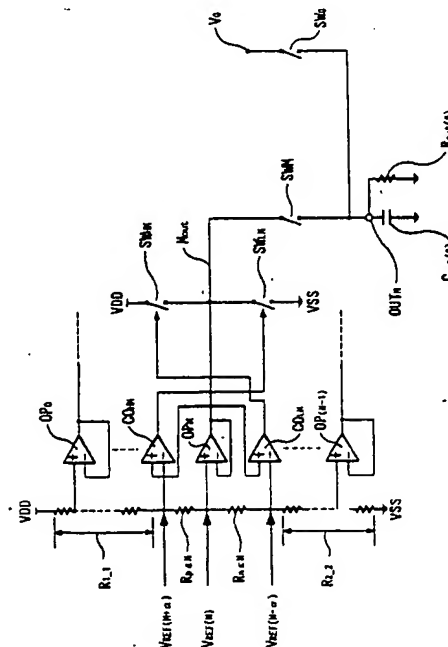
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(54) 【発明の名称】 液晶表示駆動装置

(57)【要約】

【課題】 低消費電力化、高速化、発振しにくい安定性を同時に満たす液晶表示駆動装置を提供する。

【解決手段】 電源電圧VDDとグランド電位VSS間を抵抗分圧した電圧 V_{REF} から $V_{REF(N-1)}$ をオペアンプOP₀からOP_(N-1)でインピーダンス変換し、VDDとオペアンプOP_Nの出力との間にスイッチSW_Nを付加し、VSSとオペアンプOP_Nの出力との間にスイッチSW_Lを付加し、オペアンプの出力電圧をモニターするコンパレータCO_N、CO_Lの出力信号でスイッチSW_N、SW_Lを切り替える。スイッチSW₀からスイッチSW_Nに切り替わったとき、オペアンプOP_Nの出力電圧の急激な変化に対してVDDまたはVSSの供給を用いて高速動作を可能にし、オペアンプOP_Nの出力電圧が変化しないとき（スイッチSW₀、SW_Nが切り替わらないとき）には、オペアンプOP_Nのみの動作であるので、従来と同程度の消費電流、発振に対する安定さを得ることができるところである。



【特許請求の範囲】

【請求項1】液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、

前記複数のスイッチに電圧を供給する複数のオペアンプと、

前記複数のオペアンプに基準電圧を与えるための抵抗と、

前記複数のオペアンプの出力をモニターする複数のコンパレータと、

前記複数のオペアンプの出力と電源電圧の間と前記複数のオペアンプの出力とグラウンド電位の間に介装された複数のスイッチとを備え、データ変更時に前記複数のコンパレータが前記複数のスイッチを切り替えて液晶パネルへの出力電圧を収束させるよう構成した液晶表示駆動装置。

【請求項2】データ変更時の収束時間に対する出力電流が、前記複数のオペアンプの出力電流以上の能力を備え、かつ、データ変更のない定常時には、前記複数のオペアンプの定常時電流と同等の低消費電力であることを特徴とする請求項1記載の液晶表示駆動装置。

【請求項3】液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、

前記複数のスイッチに供給する複数のオペアンプと、前記複数のオペアンプに基準電圧を与えるための抵抗と、

前記複数のオペアンプの出力をモニターする複数のコンパレータとを備え、前記複数のオペアンプの出力電圧に対して、前記複数のコンパレータによってデータ変更時にのみ、前記複数のオペアンプのバイアス、出力段を構成するトランジスタの能力を増大させることによって、前記複数のオペアンプの能力を増大させて、前記複数のオペアンプの出力電圧を収束させるよう構成した液晶表示駆動装置。

【請求項4】データ変更のあるときのみ、バイアス、出力段を構成する前記トランジスタの能力を増大させ、データ変更のない定常状態時には、バイアス、出力段の前記トランジスタの能力を低下させて、前記複数のオペアンプが低消費電力かつ、発振しにくい安定な電圧を供給するよう構成した請求項3記載の液晶表示駆動装置。

【請求項5】液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、

前記複数のスイッチに供給する複数のオペアンプ $OP_0 \sim OP_{(n-1)}$ と、

前記複数のオペアンプに基準電圧 $V_{REF(0)} \sim V_{REF(n-1)}$

を与えるための抵抗と、

前記複数のオペアンプの出力と電源との間に介装された複数のN型MOSトランジスタと、

前記複数のオペアンプの出力とグラウンド電位の間に複数のP型MOSトランジスタとを備え、液晶パネルを駆動するための所望の電圧 $V_{REF(0)} \sim V_{REF(n-1)}$ のうちの一つの電圧 $V_{REF(x)}$ をこの電圧 $V_{REF(x)}$ より前記複数のP型MOSトランジスタのしきい値電圧 V_{th} だけ高い電圧もしくは、電圧の $V_{REF(x)}$ よりN型MOSトランジスタのしきい値電圧 V_{th} だけ低い電圧付近まで、前記複数のオペアンプの駆動に加えて、電源電圧もしくはグラウンド電位で収束させ、その後前記複数のP型MOSもしくはN型MOSトランジスタのしきい値電圧分の V_{th} もしくは V_{th} 分、前記複数のオペアンプの駆動で前記複数のオペアンプの出力電圧を所望の電圧 $V_{REF(x)}$ に収束させるよう構成した液晶表示駆動装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は液晶パネルを駆動する液晶表示駆動装置に関するものである。

【0002】

【従来の技術】図9は従来の液晶表示駆動装置を示す。 $R_0, R_1, \dots, R_M, R(M+1), \dots, R_n$ は、電源電圧 V_{DD} とグラウンド電位 V_{SS} の間の電位差を抵抗分圧して基準電圧を発生させるための抵抗、 $OP_0 \sim OP_{(n-1)}$ は、抵抗分圧された電圧 $V_{REF0} \sim V_{REF(n-1)}$ をバッファするオペアンプ、 $SW_0 \sim SW_{(n-1)}, \dots, SW_M \sim SW_{(n-1)}, \dots, SW(N-1) \sim SW(N-1)_{(n-1)}$ は、オペアンプ $OP_0 \sim OP_{(n-1)}$ の出力電圧を出力するための出力選択スイッチであって、電圧 $V_{REF0} \sim V_{REF(n-1)}$ をオペアンプ $OP_0 \sim OP_{(n-1)}$ によってインピーダンスを変換し、出力選択スイッチ $SW_0 \sim SW_{(n-1)}, \dots, SW(N-1)_{(n-1)}$ のうちの選択されているスイッチ（以下、 SW_x ）から所望の電圧（以下、 $V_{REF(x)}$ ）を端子 $OUT_0 \sim OUT_{(n-1)}$ を介して液晶パネルに出力する。

【0003】

【発明が解決しようとする課題】液晶パネルを携帯機器や携帯端末に利用するためには、液晶表示駆動装置としては高精度な電圧出力に加えて、高速駆動や低消費電力ということが要求される。

【0004】この従来の構成では、スイッチ SW_x 以外のスイッチから SW_x に切り替わったとき、オペアンプ $OP_0 \sim OP_{(n-1)}$ の能力のみで駆動する必要があり、低消費電力と高速駆動の両方を満たすのは困難である。

【0005】さらに、オペアンプ $OP_0 \sim OP_{(n-1)}$ は、ボルテージフォロアの構成をとっているため、高速に駆動させると発振しやすい。本発明は、高速駆動、低消費電力、かつ発振しない安定な液晶表示駆動装置を提供することを目的とする。

【0006】

【課題を解決するための手段】本発明の請求項1に記載の液晶表示駆動装置は、液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、前記複数のスイッチに電圧を供給する複数のオペアンプと、前記複数のオペアンプに基準電圧を与えるための抵抗と、前記複数のオペアンプの出力をモニターする複数のコンパレータと、前記複数のオペアンプの出力と電源電圧の間と前記複数のオペアンプの出力とグラ

ランド電位の間に介装された複数のスイッチとを備え、データ変更時に前記複数のコンパレータが前記複数のスイッチを切り替えて液晶パネルへの出力電圧を収束させるよう構成したことを特徴とする。

【0007】さらに具体的には、本発明の請求項2に記載のように、請求項1において、データ変更時の収束時間に対する出力電流が、前記複数のオペアンプの出力電流以上の能力を備え、かつ、データ変更のない定常時には、前記複数のオペアンプの定常時電流と同等の低消費電力であることを特徴とする。

【0008】この構成によると、オペアンプの能力に依存しないで高速化でき、高速かつ発振しないという安定さを同時に満たし、さらに高速化のための消費電力はコンパレータの挿入分だけであるから、数マイクロアンペア程度で実現可能である。

【0009】本発明の請求項3に記載の液晶表示駆動装置は、液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、前記複数のスイッチに供給する複数のオペアンプと、前記複数のオペアンプに基準電圧を与えるための抵抗と、前記複数のオペアンプの出力をモニターする複数のコンパレータとを備え、前記複数のオペアンプの出力電圧に対し

て、前記複数のコンパレータによってデータ変更時のみ、前記複数のオペアンプのバイアス、出力段を構成するトランジスタの能力を増大させることによって、前記複数のオペアンプの能力を増大させて、前記複数のオペアンプの出力電圧を収束させるよう構成したことを特徴とする。

【0010】さらに具体的には、本発明の請求項4に記載のように、請求項3において、データ変更のあるときのみ、バイアス、出力段を構成する前記トランジスタの能力を増大させ、データ変更のない定常状態時には、バイアス、出力段の前記トランジスタの能力を低下させて、前記複数のオペアンプが低消費電力かつ、発振しにくい安定な電圧を供給するよう構成したことを特徴とする。

【0011】この構成によると、オペアンプの能力を変化させて、過渡状態ではバイアス及び出力段のトランジスタ能力を増大させて、高速動作、定常状態ではバイア

ス及び出力段のトランジスタ能力を低下させて、低消費電力、安定動作とを両立させることができる。

【0012】本発明の請求項5に記載の液晶表示駆動装置は、液晶パネルを駆動する複数の電圧を生成する多値電圧を供給する液晶表示駆動装置であって、液晶パネルのデータライン数に対応した複数のスイッチと、前記複数のスイッチに供給する複数のオペアンプ $OP_0 \sim OP_{(N-1)}$ と、前記複数のオペアンプに基準電圧 $V_{REF(0)} \sim V_{REF(N-1)}$ を与えるための抵抗と、前記複数のオペアンプの出力と電源との間に介装された複数のN型MOSトランジスタと、前記複数のオペアンプの出力とグラ

ランド電位の間に複数のP型MOSトランジスタとを備え、液晶パネルを駆動するための所望の電圧 $V_{REF(0)} \sim V_{REF(N-1)}$ のうちの一つの電圧 $V_{REF(x)}$ をこの電圧 $V_{REF(x)}$ より前記複数のP型MOSトランジスタのしきい値電圧 V_{th0} だけ高い電圧もしくは、電圧の $V_{REF(x)}$ よりN型MOSトランジスタのしきい値電圧 V_{thn} だけ低い電圧付近まで、前記複数のオペアンプの駆動に加えて、電源電圧もしくはグラ

ランド電位で収束させ、その後

に前記複数のP型MOSもしくはN型MOSトランジスタのしきい値電圧分の V_{thn} もしくは V_{th0} 分、前記複数のオペアンプの駆動で前記複数のオペアンプの出力電圧を所望の電圧 $V_{REF(x)}$ に収束させるよう構成したことを特徴とする。

【0013】この構成によると、データ変更のない定常時には、従来と同じ能力であっても、オペアンプ $OP_0 \sim OP_{(N-1)}$ の駆動は、電位差 $(V_{thn} + \alpha)$ もしくは $(V_{th0} + \alpha)$ で良いので、高速化可能となり、消費電力、オペアンプ $OP_0 \sim OP_{(N-1)}$ の発振に対する安定性は、従来と同程度良いということが可能となる。

【0014】

【発明の実施の形態】以下、本発明の各実施の形態を図1～図8に基づいて説明する。なお、図9に示した従来例の液晶表示駆動装置は、オペアンプ OP_0 について注目すると図10のように書ける。ここで、 V_0 は $V_{REF(0)} \sim V_{REF(N-1)}$ のうちの V_{REF0} 以外の電圧、SW₀はスイッチSW₀～SW_(N-1)のうちのスイッチSW_M以外のスイッチとする。

【0015】（実施の形態1）図1は本発明の（実施の形態1）の液晶表示駆動装置を示し、オペアンプ OP_0 に注目すると図2のように書ける。

【0016】従来のオペアンプ $OP_0 \sim OP_{(N-1)}$ の上下にコンパレータ $CO_{n0} \sim CO_{n(N-1)}$ 、 $CO_{l0} \sim CO_{l(N-1)}$ を挿入し、コンパレータ $CO_{n0} \sim CO_{n(N-1)}$ 、 $CO_{l0} \sim CO_{l(N-1)}$ の出力がスイッチSW₀～SW_(N-1)、SW_{l0} \sim SW_{l(N-1)}を介して電源電圧VDDもしくはグラ}

ランド電位VSSが、オペアンプ $OP_0 \sim OP_{(N-1)}$ の出力電圧を電圧 V_{REFx} の近傍まで駆動するものである。

【0017】図1において、 R_{v0} 、 R_{e0} 、 R_{v1} 、 R

$\alpha, \varepsilon_0, \dots, R_{V_{\alpha}}, R_0, \varepsilon_0, R_{\alpha}, \varepsilon_0, R_{V_{\alpha-1}}, \dots, R_{V_{(N-1)}}, R_0, \varepsilon_{(N-1)}, R_{\alpha}, \varepsilon_{(N-1)}, R_{V_{\alpha}}$ は、電源電圧VDDとグラウンド電位VSSの間の電位差を抵抗分圧して基準電圧を発生させるための抵抗、 $OP_0 \sim OP_{(N-1)}$ は、抵抗分圧された電圧 $V_{REF0}, \dots, V_{REFM}, \dots, V_{REF(N-1)}$ をバッファするオペアンプ、 $SW0 \sim SW0_{(N-1)}, \dots, SWM_0 \sim SWM_{(N-1)}, \dots, SW(N-1)_0 \sim SW(N-1)_{(N-1)}$ は、オペアンプ $OP_0 \sim OP_{(N-1)}$ の出力電圧を選択するための出力選択スイッチであって、端子OUT₀ ~ OUT_(N-1)から液晶パネルLCDに出力する。

【0018】 CO_{n0} はオペアンプ OP_0 の出力電圧と基準電圧 V_{REF0}, α とを比較するコンパレータ、 SW_{n0} は電源電圧VDDとオペアンプ OP_0 の出力との間に介装されたスイッチ、 CO_{L0} はオペアンプ OP_0 の出力電圧と基準電圧 V_{REF0}, α とを比較するコンパレータ、 SW_{L0} はグラウンド電位VSSとオペアンプ OP_0 の出力との間に介装されたスイッチであって、スイッチ SW_{n0} はコンパレータ CO_{L0} の出力で開閉が切り替えられ、スイッチ SW_{L0} はコンパレータ CO_{n0} の出力で開閉が切り替えられる。

【0019】以下、同様に、オペアンプ OP_n について、 CO_{nm} はオペアンプ OP_n の出力電圧と基準電圧 $V_{REF(n), \alpha}$ とを比較するコンパレータ、 SW_{nm} は電源電圧VDDとオペアンプ OP_n の出力との間に介装されたスイッチ、 CO_{Ln} はオペアンプ OP_n の出力電圧と基準電圧 $V_{REF(n), \alpha}$ とを比較するコンパレータ、 SW_{Ln} はグラウンド電位VSSとオペアンプ OP_n の出力との間に介装されたスイッチであって、スイッチ SW_{nm} はコンパレータ CO_{Ln} の出力で開閉が切り替えられ、スイッチ SW_{Ln} はコンパレータ CO_{nm} の出力で開閉が切り替えられる。

【0020】オペアンプ $OP_{(N-1)}$ について、 $CO_{(N-1)m}$ はオペアンプ $OP_{(N-1)}$ の出力電圧と基準電圧 $V_{REF((N-1)), \alpha}$ とを比較するコンパレータ、 $SW_{(N-1)m}$ は電源電圧VDDとオペアンプ $OP_{(N-1)}$ の出力との間に介装されたスイッチ、 $CO_{L(N-1)}$ はオペアンプ $OP_{(N-1)}$ の出力電圧と基準電圧 $V_{REF((N-1)), \alpha}$ とを比較するコンパレータ、 $SW_{L(N-1)}$ はグラウンド電位VSSとオペアンプ $OP_{(N-1)}$ の出力との間に介装されたスイッチであって、スイッチ $SW_{(N-1)m}$ はコンパレータ $CO_{L(N-1)}$ の出力で開閉が切り替えられ、スイッチ $SW_{L(N-1)}$ はコンパレータ $CO_{(N-1)m}$ の出力で開閉が切り替えられる。

【0021】図2に示すように、 $R_{1,1}, R_{1,2}, R_{1,3}, R_{1,4}, R_{1,5}$ は基準電圧 $V_{REF(1)}$ を発生させる抵抗であり、抵抗 $R_{1,1}$ と抵抗 $R_{1,2} \sim R_{1,5}$ で分圧した電圧 $V_{REF(1), \alpha}$ をコンパレータ CO_{n0} の反転入力端子(-)へ入力し、抵抗 $R_{1,1} \sim R_{1,2}$ と抵抗 $R_{1,3} \sim R_{1,5}$ で分圧した電圧 $V_{REF(n)}$ をオペアンプ OP_n の非反転入力端子

(+)へ入力し、抵抗 $R_{1,1} \sim R_{1,2}$ と抵抗 $R_{1,3}$ で分圧した電圧 $V_{REF(n), \alpha}$ をコンパレータ CO_{Lm} の反転入力端子(-)へ入力している。

【0022】オペアンプ OP_n はボルテージフォロア構成を取り、オペアンプ OP_n の出力 M_{n0} はコンパレータ CO_{nm} の非反転入力端子(+)と、コンパレータ CO_{Ln} の非反転入力端子(+)、ならびにスイッチ SW_n に、電圧 $V_{REF(n)}$ を供給する。

【0023】コンパレータ CO_{nm} 、 CO_{Ln} はオペアンプ OP_n の出力 M_{n0} を高速に電源電圧VDD、グラウンド電位VSSを用いて収束させる。 SW_n 、 SW_L はオペアンプ OP_n の出力 M_{n0} と他のオペアンプの出力電圧 V_0 とを出力切り替えのためのスイッチである。

【0024】このように構成された液晶表示駆動装置について、その動作を説明する。スイッチ SW_n が選択されていて、端子OUT_nに V_0 電圧が出力されている状態から、スイッチ SWM が選択されると、オペアンプ OP_n の出力電圧 $V_{REF(n)}$ が出力される。

【0025】この場合、オペアンプ OP_n の出力 M_{n0} の電圧の変化の仕方は、 $V_{REF(n)}$ よりも低い電位から $V_{REF(n)}$ へと電位が上昇して収束する場合と、 $V_{REF(n)}$ よりも高い電位から $V_{REF(n)}$ へと電位が降下して収束する場合とがある。

【0026】まず、オペアンプ OP_n の出力 M_{n0} が $V_{REF(n)}$ よりも低い電位から $V_{REF(n)}$ へと電位が上昇して収束する場合を説明する。このとき、オペアンプ OP_n の出力 M_{n0} の初期状態は電位が $V_{REF(n), \alpha}$ より高い場合、オペアンプ OP_n のみ動作して出力 M_{n0} の電位を $V_{REF(n)}$ へと収束させる。このとき、電圧レンジが電位 α ボルトと小さいので、オペアンプ OP_n の出力 M_{n0} のみで駆動しても十分、高速動作が可能である。 α ボルトは、

$$V_{REF(n), \alpha} - V_{REF(n)} = \alpha$$

$$V_{REF(n)} - V_{REF(n), \alpha} = \alpha$$

である。

【0027】しかしながら、オペアンプ OP_n の出力 M_{n0} が $V_{REF(n), \alpha}$ より小さい場合、電圧レンジが大きい。この場合には、 $V_{REF(n), \alpha}$ 付近の電位までコンパレータ CO_{Ln} がスイッチ SW_n をオンさせて、電源電圧VDDを、出力 M_{n0} に対して $V_{REF(n), \alpha}$ 付近の電圧となるまで供給する。

【0028】オペアンプ OP_n の出力 M_{n0} の電圧が $V_{REF(n), \alpha}$ 付近の電圧となったとき、コンパレータ CO_{Ln} がスイッチ SW_n をオフして電源電圧VDDからの供給を切る。このあと、オペアンプ OP_n によって、 $V_{REF(n), \alpha}$ から $V_{REF(n)}$ 電位まで上昇させて、端子OUT_nは電圧 $V_{REF(n)}$ に収束する。

【0029】このように過渡状態、すなわち、出力 M_{n0} が大きな変化する時のみ、コンパレータ CO_{Ln} で電源電圧VDDを供給するため、従来と同等のオペアン

ブOP_nの能力でありながら高速化が可能となる。

【0030】次に、オペアンプOP_nの出力M_{out}がV_{REF(M)}より高い電位からV_{REF(M)}へと電位が降下して収束する場合を説明する。このとき、端子OUT_nの初期状態は電位がV_{REF(M)}より低い場合、オペアンプOP_nのみ動作して、端子OUT_nの電位をV_{REF(M)}へと収束させる。このとき、電圧レンジが電位αと小さいオペアンプOP_nのみで駆動しても十分に高速動作が可能である。

【0031】しかしながら、オペアンプOP_nの出力M_{out}がV_{REF(M)}より大きい場合、電圧レンジが大きい。この場合には、V_{REF(M)}α₁付近の電位まで、コンパレータCO_{nM}がスイッチSW_{LM}をオンさせて、グラウンド電位VSSが、出力M_{out}に対してV_{REF(M)}α₁付近の電圧となるまで供給する。

【0032】オペアンプOP_nの出力M_{out}の電圧がV_{REF(M)}α₁付近の電圧となったとき、コンパレータCO_{nM}がスイッチSW_{LM}をオフさせて、グラウンド電位VSSからの供給を切る。このあと、オペアンプOP_nによって、V_{REF(M)}α₁からV_{REF(M)}まで上昇させて、オペア

【0033】(実施の形態2)図3～図6は本発明の(実施の形態2)の液晶表示駆動装置を示す。図3は本発明の(実施の形態2)の液晶表示駆動装置を示し、オペアンプOP₀～OP_(N-1)の上下にコンパレータCO₀～CO_(N-1)、CO_{0L}～CO_{(N-1)L}を挿入し、このコンパレータの出力をオペアンプOP₀～OP_(N-1)に入力することによって、オペアンプOP₀～OP_(N-1)のバイアス及び出力段のトランジスタ能力を過渡状態と定常状態の時で変化させる点が従来とは異なっている。

【0034】図3において、R_{V0}、R_{0E0}、R_{V1}、R_{0E1}、R_{0E2}、R_{0E3}、R_{0E4}、R_{0E5}、R_{0E6}、R_{0E7}、R_{0E8}、R_{0E9}、R_{0E10}、R_{0E11}、R_{0E12}、R_{0E13}、R_{0E14}、R_{0E15}、R_{0E16}、R_{0E17}、R_{0E18}、R_{0E19}、R_{0E20}、R_{0E21}、R_{0E22}、R_{0E23}、R_{0E24}、R_{0E25}、R_{0E26}、R_{0E27}、R_{0E28}、R_{0E29}、R_{0E30}、R_{0E31}、R_{0E32}、R_{0E33}、R_{0E34}、R_{0E35}、R_{0E36}、R_{0E37}、R_{0E38}、R_{0E39}、R_{0E40}、R_{0E41}、R_{0E42}、R_{0E43}、R_{0E44}、R_{0E45}、R_{0E46}、R_{0E47}、R_{0E48}、R_{0E49}、R_{0E50}、R_{0E51}、R_{0E52}、R_{0E53}、R_{0E54}、R_{0E55}、R_{0E56}、R_{0E57}、R_{0E58}、R_{0E59}、R_{0E60}、R_{0E61}、R_{0E62}、R_{0E63}、R_{0E64}、R_{0E65}、R_{0E66}、R_{0E67}、R_{0E68}、R_{0E69}、R_{0E70}、R_{0E71}、R_{0E72}、R_{0E73}、R_{0E74}、R_{0E75}、R_{0E76}、R_{0E77}、R_{0E78}、R_{0E79}、R_{0E80}、R_{0E81}、R_{0E82}、R_{0E83}、R_{0E84}、R_{0E85}、R_{0E86}、R_{0E87}、R_{0E88}、R_{0E89}、R_{0E90}、R_{0E91}、R_{0E92}、R_{0E93}、R_{0E94}、R_{0E95}、R_{0E96}、R_{0E97}、R_{0E98}、R_{0E99}、R_{0E100}、R_{0E101}、R_{0E102}、R_{0E103}、R_{0E104}、R_{0E105}、R_{0E106}、R_{0E107}、R_{0E108}、R_{0E109}、R_{0E110}、R_{0E111}、R_{0E112}、R_{0E113}、R_{0E114}、R_{0E115}、R_{0E116}、R_{0E117}、R_{0E118}、R_{0E119}、R_{0E120}、R_{0E121}、R_{0E122}、R_{0E123}、R_{0E124}、R_{0E125}、R_{0E126}、R_{0E127}、R_{0E128}、R_{0E129}、R_{0E130}、R_{0E131}、R_{0E132}、R_{0E133}、R_{0E134}、R_{0E135}、R_{0E136}、R_{0E137}、R_{0E138}、R_{0E139}、R_{0E140}、R_{0E141}、R_{0E142}、R_{0E143}、R_{0E144}、R_{0E145}、R_{0E146}、R_{0E147}、R_{0E148}、R_{0E149}、R_{0E150}、R_{0E151}、R_{0E152}、R_{0E153}、R_{0E154}、R_{0E155}、R_{0E156}、R_{0E157}、R_{0E158}、R_{0E159}、R_{0E160}、R_{0E161}、R_{0E162}、R_{0E163}、R_{0E164}、R_{0E165}、R_{0E166}、R_{0E167}、R_{0E168}、R_{0E169}、R_{0E170}、R_{0E171}、R_{0E172}、R_{0E173}、R_{0E174}、R_{0E175}、R_{0E176}、R_{0E177}、R_{0E178}、R_{0E179}、R_{0E180}、R_{0E181}、R_{0E182}、R_{0E183}、R_{0E184}、R_{0E185}、R_{0E186}、R_{0E187}、R_{0E188}、R_{0E189}、R_{0E190}、R_{0E191}、R_{0E192}、R_{0E193}、R_{0E194}、R_{0E195}、R_{0E196}、R_{0E197}、R_{0E198}、R_{0E199}、R_{0E200}、R_{0E201}、R_{0E202}、R_{0E203}、R_{0E204}、R_{0E205}、R_{0E206}、R_{0E207}、R_{0E208}、R_{0E209}、R_{0E210}、R_{0E211}、R_{0E212}、R_{0E213}、R_{0E214}、R_{0E215}、R_{0E216}、R_{0E217}、R_{0E218}、R_{0E219}、R_{0E220}、R_{0E221}、R_{0E222}、R_{0E223}、R_{0E224}、R_{0E225}、R_{0E226}、R_{0E227}、R_{0E228}、R_{0E229}、R_{0E230}、R_{0E231}、R_{0E232}、R_{0E233}、R_{0E234}、R_{0E235}、R_{0E236}、R_{0E237}、R_{0E238}、R_{0E239}、R_{0E240}、R_{0E241}、R_{0E242}、R_{0E243}、R_{0E244}、R_{0E245}、R_{0E246}、R_{0E247}、R_{0E248}、R_{0E249}、R_{0E250}、R_{0E251}、R_{0E252}、R_{0E253}、R_{0E254}、R_{0E255}、R_{0E256}、R_{0E257}、R_{0E258}、R_{0E259}、R_{0E260}、R_{0E261}、R_{0E262}、R_{0E263}、R_{0E264}、R_{0E265}、R_{0E266}、R_{0E267}、R_{0E268}、R_{0E269}、R_{0E270}、R_{0E271}、R_{0E272}、R_{0E273}、R_{0E274}、R_{0E275}、R_{0E276}、R_{0E277}、R_{0E278}、R_{0E279}、R_{0E280}、R_{0E281}、R_{0E282}、R_{0E283}、R_{0E284}、R_{0E285}、R_{0E286}、R_{0E287}、R_{0E288}、R_{0E289}、R_{0E290}、R_{0E291}、R_{0E292}、R_{0E293}、R_{0E294}、R_{0E295}、R_{0E296}、R_{0E297}、R_{0E298}、R_{0E299}、R_{0E300}、R_{0E301}、R_{0E302}、R_{0E303}、R_{0E304}、R_{0E305}、R_{0E306}、R_{0E307}、R_{0E308}、R_{0E309}、R_{0E310}、R_{0E311}、R_{0E312}、R_{0E313}、R_{0E314}、R_{0E315}、R_{0E316}、R_{0E317}、R_{0E318}、R_{0E319}、R_{0E320}、R_{0E321}、R_{0E322}、R_{0E323}、R_{0E324}、R_{0E325}、R_{0E326}、R_{0E327}、R_{0E328}、R_{0E329}、R_{0E330}、R_{0E331}、R_{0E332}、R_{0E333}、R_{0E334}、R_{0E335}、R_{0E336}、R_{0E337}、R_{0E338}、R_{0E339}、R_{0E340}、R_{0E341}、R_{0E342}、R_{0E343}、R_{0E344}、R_{0E345}、R_{0E346}、R_{0E347}、R_{0E348}、R_{0E349}、R_{0E350}、R_{0E351}、R_{0E352}、R_{0E353}、R_{0E354}、R_{0E355}、R_{0E356}、R_{0E357}、R_{0E358}、R_{0E359}、R_{0E360}、R_{0E361}、R_{0E362}、R_{0E363}、R_{0E364}、R_{0E365}、R_{0E366}、R_{0E367}、R_{0E368}、R_{0E369}、R_{0E370}、R_{0E371}、R_{0E372}、R_{0E373}、R_{0E374}、R_{0E375}、R_{0E376}、R_{0E377}、R_{0E378}、R_{0E379}、R_{0E380}、R_{0E381}、R_{0E382}、R_{0E383}、R_{0E384}、R_{0E385}、R_{0E386}、R_{0E387}、R_{0E388}、R_{0E389}、R_{0E390}、R_{0E391}、R_{0E392}、R_{0E393}、R_{0E394}、R_{0E395}、R_{0E396}、R_{0E397}、R_{0E398}、R_{0E399}、R_{0E400}、R_{0E401}、R_{0E402}、R_{0E403}、R_{0E404}、R_{0E405}、R_{0E406}、R_{0E407}、R_{0E408}、R_{0E409}、R_{0E410}、R_{0E411}、R_{0E412}、R_{0E413}、R_{0E414}、R_{0E415}、R_{0E416}、R_{0E417}、R_{0E418}、R_{0E419}、R_{0E420}、R_{0E421}、R_{0E422}、R_{0E423}、R_{0E424}、R_{0E425}、R_{0E426}、R_{0E427}、R_{0E428}、R_{0E429}、R_{0E430}、R_{0E431}、R_{0E432}、R_{0E433}、R_{0E434}、R_{0E435}、R_{0E436}、R_{0E437}、R_{0E438}、R_{0E439}、R_{0E440}、R_{0E441}、R_{0E442}、R_{0E443}、R_{0E444}、R_{0E445}、R_{0E446}、R_{0E447}、R_{0E448}、R_{0E449}、R_{0E450}、R_{0E451}、R_{0E452}、R_{0E453}、R_{0E454}、R_{0E455}、R_{0E456}、R_{0E457}、R_{0E458}、R_{0E459}、R_{0E460}、R_{0E461}、R_{0E462}、R_{0E463}、R_{0E464}、R_{0E465}、R_{0E466}、R_{0E467}、R_{0E468}、R_{0E469}、R_{0E470}、R_{0E471}、R_{0E472}、R_{0E473}、R_{0E474}、R_{0E475}、R_{0E476}、R_{0E477}、R_{0E478}、R_{0E479}、R_{0E480}、R_{0E481}、R_{0E482}、R_{0E483}、R_{0E484}、R_{0E485}、R_{0E486}、R_{0E487}、R_{0E488}、R_{0E489}、R_{0E490}、R_{0E491}、R_{0E492}、R_{0E493}、R_{0E494}、R_{0E495}、R_{0E496}、R_{0E497}、R_{0E498}、R_{0E499}、R_{0E500}、R_{0E501}、R_{0E502}、R_{0E503}、R_{0E504}、R_{0E505}、R_{0E506}、R_{0E507}、R_{0E508}、R_{0E509}、R_{0E510}、R_{0E511}、R_{0E512}、R_{0E513}、R_{0E514}、R_{0E515}、R_{0E516}、R_{0E517}、R_{0E518}、R_{0E519}、R_{0E520}、R_{0E521}、R_{0E522}、R_{0E523}、R_{0E524}、R_{0E525}、R_{0E526}、R_{0E527}、R_{0E528}、R_{0E529}、R_{0E530}、R_{0E531}、R_{0E532}、R_{0E533}、R_{0E534}、R_{0E535}、R_{0E536}、R_{0E537}、R_{0E538}、R_{0E539}、R_{0E540}、R_{0E541}、R_{0E542}、R_{0E543}、R_{0E544}、R_{0E545}、R_{0E546}、R_{0E547}、R_{0E548}、R_{0E549}、R_{0E550}、R_{0E551}、R_{0E552}、R_{0E553}、R_{0E554}、R_{0E555}、R_{0E556}、R_{0E557}、R_{0E558}、R_{0E559}、R_{0E560}、R_{0E561}、R_{0E562}、R_{0E563}、R_{0E564}、R_{0E565}、R_{0E566}、R_{0E567}、R_{0E568}、R_{0E569}、R_{0E570}、R_{0E571}、R_{0E572}、R_{0E573}、R_{0E574}、R_{0E575}、R_{0E576}、R_{0E577}、R_{0E578}、R_{0E579}、R_{0E580}、R_{0E581}、R_{0E582}、R_{0E583}、R_{0E584}、R_{0E585}、R_{0E586}、R_{0E587}、R_{0E588}、R_{0E589}、R_{0E590}、R_{0E591}、R_{0E592}、R_{0E593}、R_{0E594}、R_{0E595}、R_{0E596}、R_{0E597}、R_{0E598}、R_{0E599}、R_{0E600}、R_{0E601}、R_{0E602}、R_{0E603}、R_{0E604}、R_{0E605}、R_{0E606}、R_{0E607}、R_{0E608}、R_{0E609}、R_{0E610}、R_{0E611}、R_{0E612}、R_{0E613}、R_{0E614}、R_{0E615}、R_{0E616}、R_{0E617}、R_{0E618}、R_{0E619}、R_{0E620}、R_{0E621}、R_{0E622}、R_{0E623}、R_{0E624}、R_{0E625}、R_{0E626}、R_{0E627}、R_{0E628}、R_{0E629}、R_{0E630}、R_{0E631}、R_{0E632}、R_{0E633}、R_{0E634}、R_{0E635}、R_{0E636}、R_{0E637}、R_{0E638}、R_{0E639}、R_{0E640}、R_{0E641}、R_{0E642}、R_{0E643}、R_{0E644}、R_{0E645}、R_{0E646}、R_{0E647}、R_{0E648}、R_{0E649}、R_{0E650}、R_{0E651}、R_{0E652}、R_{0E653}、R_{0E654}、R_{0E655}、R_{0E656}、R_{0E657}、R_{0E658}、R_{0E659}、R_{0E660}、R_{0E661}、R_{0E662}、R_{0E663}、R_{0E664}、R_{0E665}、R_{0E666}、R_{0E667}、R_{0E668}、R_{0E669}、R_{0E670}、R_{0E671}、R_{0E672}、R_{0E673}、R_{0E674}、R_{0E675}、R_{0E676}、R_{0E677}、R_{0E678}、R_{0E679}、R_{0E680}、R_{0E681}、R_{0E682}、R_{0E683}、R_{0E684}、R_{0E685}、R_{0E686}、R_{0E687}、R_{0E688}、R_{0E689}、R_{0E690}、R_{0E691}、R_{0E692}、R_{0E693}、R_{0E694}、R_{0E695}、R_{0E696}、R_{0E697}、R_{0E698}、R_{0E699}、R_{0E700}、R_{0E701}、R_{0E702}、R_{0E703}、R_{0E704}、R_{0E705}、R_{0E706}、R_{0E707}、R_{0E708}、R_{0E709}、R_{0E710}、R_{0E711}、R_{0E712}、R_{0E713}、R_{0E714}、R_{0E715}、R_{0E716}、R_{0E717}、R_{0E718}、R_{0E719}、R_{0E720}、R_{0E721}、R_{0E722}、R_{0E723}、R_{0E724}、R_{0E725}、R_{0E726}、R_{0E727}、R_{0E728}、R_{0E729}、R_{0E730}、R_{0E731}、R_{0E732}、R_{0E733}、R_{0E734}、R_{0E735}、R_{0E736}、R_{0E737}、R_{0E738}、R_{0E739}、R_{0E740}、R_{0E741}、R_{0E742}、R_{0E743}、R_{0E744}、R_{0E745}、R_{0E746}、R_{0E747}、R_{0E748}、R_{0E749}、R_{0E750}、R_{0E751}、R_{0E752}、R_{0E753}、R_{0E754}、R_{0E755}、R_{0E756}、R_{0E757}、R_{0E758}、R_{0E759}、R_{0E760}、R_{0E761}、R_{0E762}、R_{0E763}、R_{0E764}、R_{0E765}、R_{0E766}、R_{0E767}、R_{0E768}、R_{0E769}、R_{0E770}、R_{0E771}、R_{0E772}、R_{0E773}、R_{0E774}、R_{0E775}、R_{0E776}、R_{0E777}、R_{0E778}、R_{0E779}、R_{0E780}、R_{0E781}、R_{0E782}、R_{0E783}、R_{0E784}、R_{0E785}、R_{0E786}、R_{0E787}、R_{0E788}、R_{0E789}、R_{0E790}、R_{0E791}、R_{0E792}、R_{0E793}、R_{0E794}、R_{0E795}、R_{0E796}、R_{0E797}、R_{0E798}、R_{0E799}、R_{0E800}、R_{0E801}、R_{0E802}、R_{0E803}、R_{0E804}、R_{0E805}、R_{0E806}、R_{0E807}、R_{0E808}、R_{0E809}、R_{0E810}、R_{0E811}、R_{0E812}、R_{0E813}、R_{0E814}、R_{0E815}、R_{0E816}、R_{0E817}、R_{0E818}、R_{0E819}、R_{0E820}、R_{0E821}、R_{0E822}、R_{0E823}、R_{0E824}、R_{0E825}、R_{0E826}、R_{0E827}、R_{0E828}、R_{0E829}、R_{0E830}、R_{0E831}、R_{0E832}、R_{0E833}、R_{0E834}、R_{0E835}、R_{0E836}、R_{0E837}、R_{0E838}、R_{0E839}、R_{0E840}、R_{0E841}、R_{0E842}、R_{0E843}、R_{0E844}、R_{0E845}、R_{0E846}、R_{0E847}、R_{0E848}、R_{0E849}、R_{0E850}、R_{0E851}、R_{0E852}、R_{0E853}、R_{0E854}、R_{0E855}、R_{0E856}、R_{0E857}、R_{0E858}、R_{0E859}、R_{0E860}、R_{0E861}、R_{0E862}、R_{0E863}、R_{0E864}、R_{0E865}、R_{0E866}、R_{0E867}、R_{0E868}、R_{0E869}、R_{0E870}、R_{0E871}、R_{0E872}、R_{0E873}、R_{0E874}、R_{0E875}、R_{0E876}、R_{0E877}、R_{0E878}、R_{0E879}、R_{0E880}、R_{0E}

出力 M_{out} の電位を V_{refw} へと収束させる。このとき、電圧レンジが α と小さいので、オペアンプ OP_* のみで駆動しても十分、高速動作が可能である。

【0043】また、このときコンパレータ CO_{in} はオペアンプ OP_* に対して、制御信号として“L”レベルの信号を出力し、その結果、図5のスイッチ SW_{n1} 、 SW_{n2} が電源電圧 VDD とつながり、図5の SW_{L1} 、 SW_{L2} がグラウンド電位 VSS とつながり、オペアンプ OP_* の入力側のバイアスは、トランジスタ $MP1$ 、 $MN1$ を介してバイアスされる。オペアンプ OP_* の出力側は、トランジスタ $MP3$ 、 $MN3$ を介してバイアスされ、トランジスタ $MP2$ 、 $MP4$ 、 $MN2$ 、 $MN4$ は動作しないので、オペアンプ OP_* は、低消費電力で、かつ発振に対する高い安定性を持つ。

【0044】しかしながら、オペアンプ OP_* の出力 M_{out} が V_{refw} より小さい場合は電圧レンジが大きい。この場合には V_{refw} 付近の電位までコンパレータ CO_{in} が制御信号として“H”レベルの信号を出す。これによって、オペアンプ OP_* の内部に付加した SW_{n1} 、 SW_{n2} 、 SW_{L1} 、 SW_{L2} が切り替わってトランジスタ $MP2$ 、 $MP4$ 、 $MN2$ 、 $MN4$ をオン状態とするため、オペアンプ OP_* のバイアス、出力段の能力が上がり、その結果、オペアンプ OP_* の周波数特性、出力ドライブ能力が上がる。

【0045】やがて、オペアンプ OP_* の出力 M_{out} の電位が V_{refw} 付近まで上昇すると、コンパレータ CO_{in} が制御信号として“L”レベルの信号を出力して、オペアンプ OP_* のトランジスタ $MP2$ 、 $MP4$ 、 $MN2$ 、 $MN4$ をオフ状態させる。これによってオペアンプ OP_* のバイアス、出力段のトランジスタは、トランジスタの付加されない状態に戻り、低消費電力で、かつ発振に対する高い安定性を持つ状態となる。

【0046】次に、オペアンプ OP_* の出力 M_{out} が V_{refw} より高い電位から V_{refw} へと電位が降下して収束する場合を説明する。このとき、オペアンプ OP_* の出力 M_{out} の初期状態は電位が V_{refw} より高い場合、オペアンプ OP_* のみ動作して、オペアンプ OP_* の出力 M_{out} の電位を V_{refw} へと収束させる。このとき、電圧レンジが α と小さいので、先のオペアンプ OP_* の出力 M_{out} が上昇した場合と同様に、オペアンプ OP_* のみで駆動しても、高速動作が可能であり、かつ低消費電力で、かつ発振に対する高い安定性を持つ。

【0047】しかしながら、オペアンプ OP_* の出力 M_{out} が V_{refw} より大きい場合、電圧レンジが大きい。この場合には、 V_{refw} 付近の電位まで、コンパレータ CO_{in} が制御信号として“H”レベルの信号を出力して、オペアンプ OP_* の内部に付加した SW_{n1} 、 SW_{n2} 、 SW_{L1} 、 SW_{L2} が切り替わってトランジスタ $MP2$ 、 $MP4$ 、 $MN2$ 、 $MN4$ をオン状態になる。これによってオペアンプ OP_* のバイアス、出力段の能力が

上がり、その結果、オペアンプ OP_* の周波数特性、出力ドライブ能力を上げる。

【0048】やがて、オペアンプ OP_* の出力 M_{out} の電位が V_{refw} 付近まで降下すると、コンパレータ CO_{in} が制御信号として“L”レベルの信号を出力して、オペアンプ OP_* の内部に付加した SW_{n1} 、 SW_{n2} 、 SW_{L1} 、 SW_{L2} が切り替わってトランジスタ $MP2$ 、 $MP4$ 、 $MN2$ 、 $MN4$ がオフ状態となる。これによってオペアンプ OP_* のバイアス、出力段のトランジスタは、トランジスタの付加されない状態に戻り、低消費電力で、かつ発振に対する高い安定性を持つ状態となる。

【0049】したがって、液晶表示駆動装置は、データが変更されない状態では、発振に対する高い安定性と消費電力でありながら、データが変更されるときに高速化できる。

【0050】動作をさらに詳しく説明する。オペアンプ OP_* の出力 M_{out} の電位が電圧 V_{refw} より低い場合に、コンパレータ CO_{in} は制御信号として“H”レベルの信号を出力し、コンパレータ CO_{in} は制御信号として“L”レベルの信号を出力する。これにより、図5に示したオペアンプ OP_* のスイッチ SW_{n1} 、 SW_{n2} 、 SW_{L1} 、 SW_{L2} が図6に示すように動作する。

【0051】この状態は、スイッチ SW_{n1} 、 SW_{L1} の動作によって、トランジスタ $MP2$ 、 $MN2$ のゲートにもバイアス P 、バイアス N が印加されて、オペアンプ OP_* の周波数特性が向上する。さらに、スイッチ SW_{n2} によってトランジスタ $MP4$ のゲートにも入力信号が印加されて出力電流能力が向上する。

【0052】これによって、オペアンプ OP_* の出力 M_{out} は、 V_{refw} より低い電位から V_{refw} まで高速動作が可能となる。次に、オペアンプ OP_* の出力 M_{out} の電位が電圧 V_{refw} と V_{refw} の間の場合には、コンパレータ CO_{in} は制御信号として“L”レベルの信号を出力し、コンパレータ CO_{in} は制御信号として“L”レベルの信号を出力する。これにより図6に示すように動作する。

【0053】この状態のときには、オペアンプ OP_* の出力 M_{out} の基準電圧との電位差は 2α 以内であるので、オペアンプ OP_* の能力を下げて低消費電力化させる。このとき、図5の差動バイアス回路はトランジスタ $MP1$ 、 $MN1$ 、出力用トランジスタ $MP3$ 、 $MN4$ で構成され、オペアンプ OP_* の周波数特性、電流能力が共に小さい。しかし、差動増幅バイアス回路をトランジスタ $MP1$ 、 $MN1$ 、出力用トランジスタを $MP3$ 、 $MN4$ で構成できるので低消費電力化が可能となる。

【0054】また、オペアンプ OP_* の出力 M_{out} の電位が電圧 V_{refw} より低い場合には、コンパレータ CO_{in} は制御信号として“L”レベルの信号を出力し、コンパレータ CO_{in} は制御信号として“H”レベルの信号を出力する。これにより図5に示したオペアンプ OP_*

のスイッチ SW_{n1} 、 SW_{n2} 、 SW_{L1} が図6に示すように動作する。さらに、スイッチ SW_{L1} によって出力用トランジスタがトランジスタ $MP3$ 、 $MP4$ となり、出力電流能力が向上する。

【0055】この状態は、スイッチ SW_{n1} 、 SW_{L1} の動作によって、トランジスタ $MP2$ 、 $MN2$ のゲートにもバイアス P 、バイアス N が印加されて、オペアンプ OP の周波数特性が向上する。これによって、オペアンプ OP の出力 M_{out} は $V_{REF(n), \alpha}$ より高い電位から $V_{REF(n), \alpha}$ まで高速動作が可能となる。

【0056】(実施の形態3) 図7と図8は本発明の(実施の形態3)の液晶表示駆動装置を示す。図7において、 R_{v0} 、 $R_{\epsilon 0}$ 、 R_{v1} 、 $R_{\epsilon 0}$ 、 \dots 、 R_{vn} 、 $R_{\epsilon n}$ 、 $R_{\epsilon n}$ 、 $R_{v(n-1)}$ 、 \dots 、 $R_{v(n-1)}$ 、 $R_{\epsilon(n-1)}$ 、 $R_{\epsilon(n-1)}$ 、 R_{vn} は、電源電圧 VDD とグラウンド電位 VSS の間の電位差を抵抗分圧して基準電圧を発生させるための抵抗、 $OP_0 \sim OP_{(n-1)}$ は、抵抗分圧された電圧 V_{REF0} 、 \dots 、 V_{REFn} 、 \dots 、 $V_{REF(n-1)}$ をバッファするオペアンプ、 $SW_0 \sim SW_0_{(n-1)}$ 、 \dots 、 $SW_n \sim SW_{n(n-1)}$ 、 \dots 、 $SW_{(N-1)} \sim SW_{(N-1)(n-1)}$ は、オペアンプ $OP_0 \sim OP_{(n-1)}$ の出力電圧を選択するための出力選択スイッチであって、端子 $OUT_0 \sim OUT_{(n-1)}$ から液晶パネルLCDに出力する。

【0057】 MN_n はゲートに基準電圧 $V_{REF0, \alpha}$ が印加されたN型MOSトランジスタ、 MP_L はゲートに基準電圧 $V_{REF0, \alpha}$ が印加されたP型MOSトランジスタであって、バッファ接続されたオペアンプ OP_0 の出力と電源電圧 VDD との間にトランジスタ MN_n の出力回路が介装されている。トランジスタ MP_L の出力回路はオペアンプ OP_0 の出力とグラウンド電位 VSS との間に介装されている。

【0058】以下、同様に、オペアンプ OP_n について、 MN_n はゲートに基準電圧 $V_{REF(n), \alpha}$ が印加されたN型MOSトランジスタ、 MP_L はゲートに基準電圧 $V_{REF(n), \alpha}$ が印加されたP型MOSトランジスタであって、バッファ接続されたオペアンプ OP_n の出力と電源電圧 VDD との間にトランジスタ MN_n の出力回路が介装されている。トランジスタ MP_L の出力回路はオペアンプ OP_n の出力とグラウンド電位 VSS との間に介装されている。

【0059】オペアンプ $OP_{(n-1)}$ について、 $MN_{(n-1)}$ はゲートに基準電圧 $V_{REF(n-1), \alpha}$ が印加されたN型MOSトランジスタ、 $MP_{(n-1)}$ はゲートに基準電圧 $V_{REF(n-1), \alpha}$ が印加されたP型MOSトランジスタであって、バッファ接続されたオペアンプ $OP_{(n-1)}$ の出力と電源電圧 VDD との間にトランジスタ $MN_{(n-1)}$ の出力回路が介装されている。トランジスタ $MP_{(n-1)}$ の出力回路はオペアンプ $OP_{(n-1)}$ の出力とグラウンド電位 VSS との間に介装されている。

【0060】図7において、オペアンプ OP_n に注目すると図8のように書ける。図8に示すように、抵抗 R_{1-} 、 R_{1-} 、 $R_{\epsilon n}$ 、 $R_{\epsilon n}$ は基準電圧を発生させる抵抗であり、抵抗 R_{1-3} と抵抗 $R_{\epsilon n} \sim R_{1-}$ で分圧した電圧 $V_{REF(n), \alpha}$ をトランジスタ MN_n のゲートに接続し、トランジスタ MN_n のドレインを電源電圧 VDD に、ソースをオペアンプ OP_n の出力 M_{out} に接続する。さらに、抵抗 R_{1-} と抵抗 $R_{\epsilon n}$ と抵抗 R_{1-} で分圧した電圧 $V_{REF(n), \alpha}$ をトランジスタ MP_L のゲートに接続し、トランジスタ MP_L のドレインをグラウンド電位 VSS に、ソースをオペアンプ OP_n の出力 M_{out} に接続する。また、 $R_{1-} \sim R_{\epsilon n}$ と $R_{\epsilon n} \sim R_{1-}$ で分圧した電圧 $V_{REF(n)}$ をオペアンプ OP_n の非反転入力(+)に印加し、オペアンプ OP_n をボルテージフォロアの構成として、スイッチ SW_n を介して出力する。また、スイッチ SW_n が選択されていないときには、スイッチ SW_0 を介して、他のオペアンプの出力電圧 V_0 が出力される。

【0061】このように構成された液晶表示装置について、以下にその動作を説明する。スイッチ SW_0 が選択されていて、 $V_{REF(n)}$ 以外の電圧が出力されている状態から、スイッチ SW_n が選択されると、オペアンプ OP_n の出力電圧に $V_{REF(n)}$ が出力される。

【0062】この場合、オペアンプ OP_n の出力 M_{out} の電圧変化の仕方は、 $V_{REF(n)}$ より低い電圧から、 $V_{REF(n)}$ へと上昇する場合と $V_{REF(n)}$ より低い電圧から降下して収束する場合とがある。

【0063】まず、オペアンプ OP_n の出力 M_{out} が $V_{REF(n)}$ より低い電位から、 $V_{REF(n)}$ へと電位が上昇して収束する場合を説明する。このとき、トランジスタ MN_n のしきい値電圧を V_{thn} とすると、端子 OUT_n が、 $(V_{REF(n), \alpha} - V_{thn})$ より大きい場合、電圧レンジが $(\alpha - V_{thn})$ と小さいので、オペアンプ OP_n のみでも高速に $V_{REF(n)}$ に収束させることができる。

【0064】しかしながら、 $(V_{REF(n), \alpha} - V_{thn})$ より小さい場合は電圧レンジが大きい。この場合には、 $(V_{REF(n), \alpha} - V_{thn})$ までトランジスタ MN_n がオンし、電源電圧 VDD をオペアンプ OP_n の出力 M_{out} に供給し $(V_{REF(n), \alpha} - V_{thn})$ まで供給する。オペアンプ OP_n の出力 M_{out} が $(V_{REF(n), \alpha} - V_{thn})$ までくるとトランジスタ MN_n がオフし電源電圧 VDD から供給を断ち、 $(V_{REF(n), \alpha} - V_{thn})$ から $V_{REF(n)}$ までオペアンプ OP_n が収束させる。

【0065】次に、オペアンプ OP_n の出力 M_{out} が $V_{REF(n)}$ より高い電位から、 $V_{REF(n)}$ へと電位が降下して収束する場合を説明する。このとき、トランジスタ MP_L のしきい値電圧 V_{thn} とすると、オペアンプ OP_n の出力 M_{out} が、 $(V_{REF(n), \alpha} + V_{thn})$ よりも小さい場合、電圧レンジが $(-\alpha + V_{thn})$ と小さいので、オペアンプ OP_n のみでも高速に $V_{REF(n)}$ に収束させることができる。

[0 0 6 7]

【図面の簡単な説明】

【図 2】同実施の形態の説明図

【図 4】同実施の形態の説明図

【図5】同実施の形態のオペアンプの回路図

【図 8】同実施の形態の説明図

【図 10】同従来例の説明図

【符号の説明】

VDD 電源電圧

10 VSS グランド電位

$V_{REF(0)} \sim V_{REF(N)}$ VDD と VSS を $R_0 \sim R_N$ で分圧した電圧の N 番目の電圧

 $V_{REF(M)}$ VDD と VSS を抵抗 $R_0 \sim R_M$ と抵抗 R

$(n-1)$ と R_n で分圧した電圧

V_0 $V_{REF(M)}$ 以外の $V_{REF(0)}$ から $V_{REF(N-1)}$ の中の
うちの1つの電圧

 $V_{REF(M-\alpha)}$, $V_{REF(M)}$ より $\alpha (>0)$ 高い電圧

20. $V_{REF(M-\alpha)}$: $V_{REF(M)}$ より $\alpha (>0)$ 低い電圧

$$OP_0 \sim OP_{(N-1)}, OP_M \quad \text{オペアンプ}$$

SW0₀~SW(N-1)_(N-1) スイッチ

SW_{HM}, SW_{LM} スイッチ

CO_{HM}, CO_{LM} コンバレータ

SW_{H1}, SW_{H2} スイッチ

SW_{L1}, SW_{L2} スイッチ

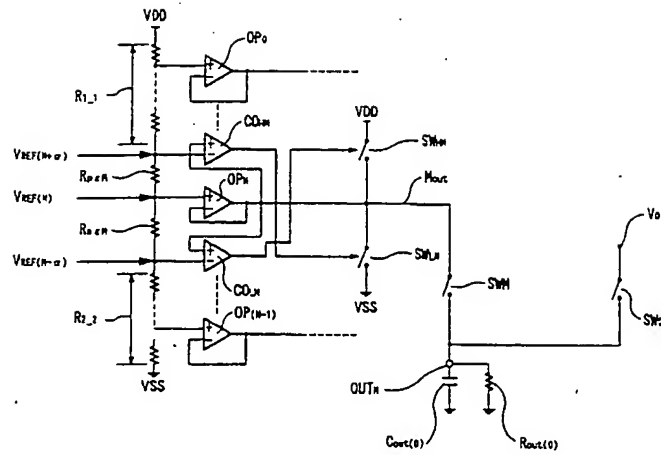
MP1~MP4 P型MOSトランジスタ

MN1~MN4 N型MOSトランジスタ

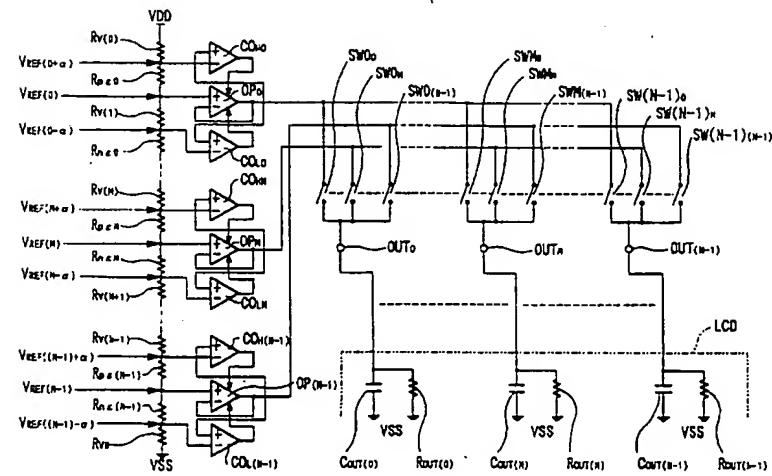
MP_{L0}~MP_{L(N-1)} P型MOSトランジスタ30 $MN_{H0} \sim MN_{H(N-1)}$ N型MOSトランジスタ

*

〔図2〕



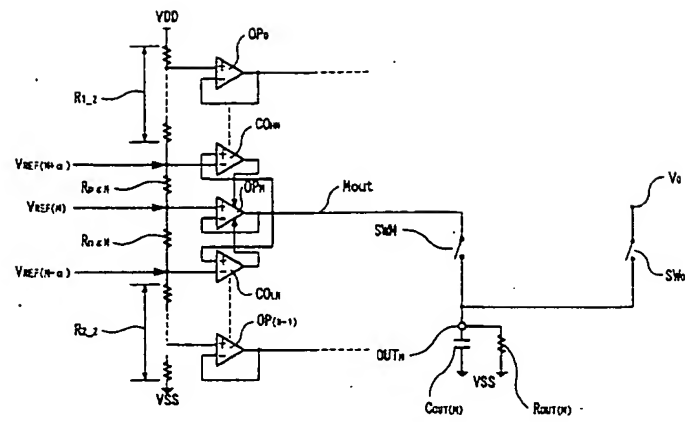
〔図3〕



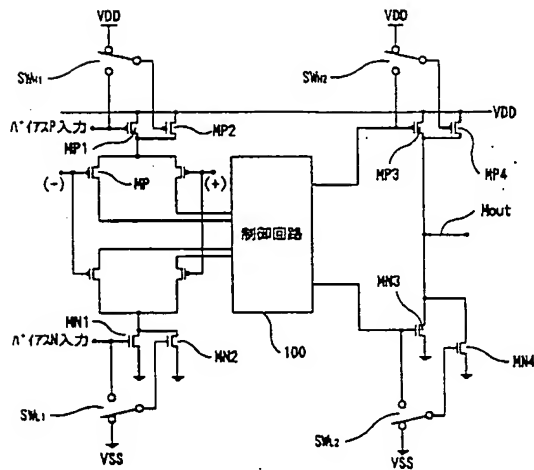
〔図6〕

CO ₀	CO ₁	SW ₀	SW ₁	SW ₂	SW ₃	16'アンプ0Pmの消費電流	16'アンプ0Pmの出力
L	-	YD0	YD0	VSS	VSS	小	小
L	H	A'172P	MU3'アンプ電圧	A'172J	VSS	大	大
H	L	A'172P	YD0	A'172J	MU3'アンプ電圧	大	大
H	H	-	-	-	-	-	-

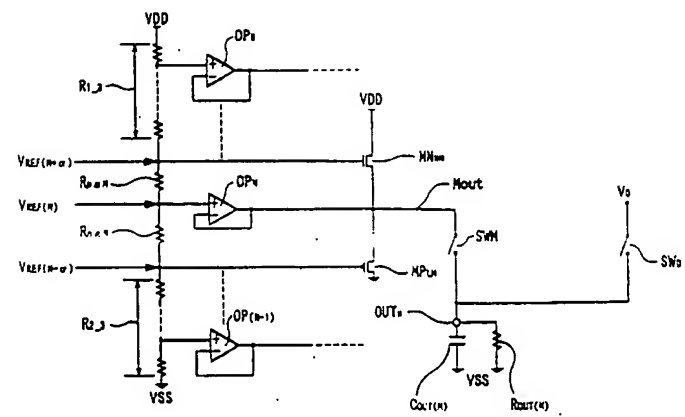
〔図4〕



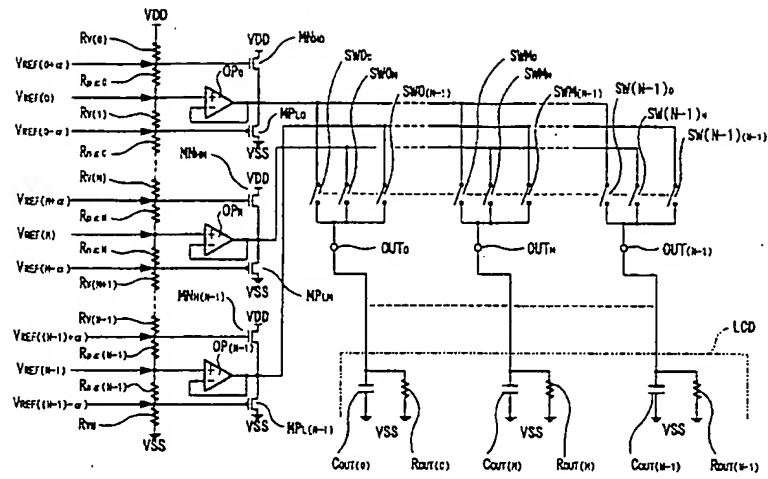
〔図5〕



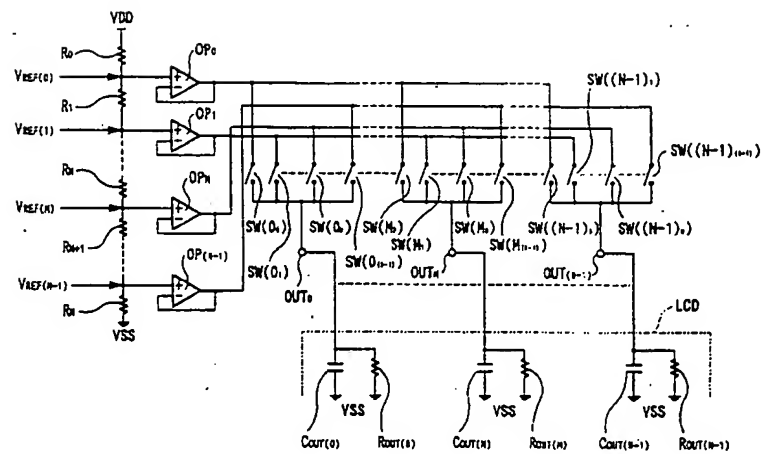
〔図8〕



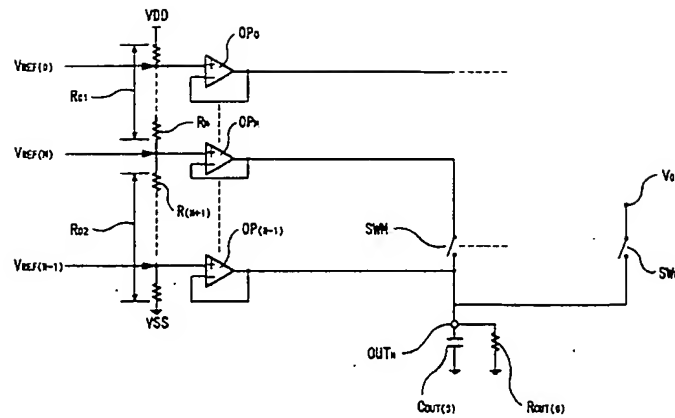
(図 7)



(図 9)



{ 図 10 }



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(72)発明者 中島 香

大阪府門真市大字門真1006番地 松下シス
テムテクノ株式会社内

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KK07

5J055 AX00 AX02 AX13 BX02 BX09

BX16 CX30 DX22 DX56 DX73

DX83 EX07 EY01 EY10 EY21

EZ07 EZ09 EZ51 FX18 FX38

GX00 GX01 GX02

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CLAIMS

[Claim(s)]

[Claim 1] Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers which supply an electrical potential difference to said two or more switches, and the resistance for giving reference voltage to said two or more operational amplifiers, Two or more comparators which act as the monitor of the output of two or more of said operational amplifiers, It has the output of two or more of said operational amplifiers, and two or more switches infixed between ground potential between the output of two or more of said operational amplifiers, and supply voltage. The liquid crystal display driving gear constituted so that said two or more comparators might change said two or more switches at the time of data modification and the output voltage to a liquid crystal panel might be completed as it.

[Claim 2] The liquid crystal display driving gear according to claim 1 characterized by being a low power equivalent to a current at the time of the stationary of two or more of said operational amplifiers at the time of the stationary which the output current over the convergence time amount at the time of data modification is equipped with the capacity beyond the output current of

two or more of said operational amplifiers, and does not have data modification.

[Claim 3] Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers supplied to said two or more switches, and the resistance for giving reference voltage to said two or more operational amplifiers, Have two or more comparators which act as the monitor of the output of two or more of said operational amplifiers, and the output voltage of two or more of said operational amplifiers is received. By increasing the bias of two or more of said operational amplifiers, and the capacity of the transistor which constitutes an output stage with said two or more comparators only at the time of data modification The liquid crystal display driving gear constituted so that the capacity of two or more of said operational amplifiers might be increased and the output voltage of two or more of said operational amplifiers might be completed.

[Claim 4] The liquid crystal display driving gear according to claim 3 constituted so that the capacity of said transistor which constitutes bias and an output stage might be increased, the capacity of said transistor of bias and an output stage might be reduced at the time of a steady state without data modification and said two or more operational amplifiers might supply a low power and the stable electrical potential difference which is hard to oscillate, only when there was data modification.

[Claim 5] Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers OP0-OP (N-1) supplied to said two or more switches, The resistance for giving reference voltage VREF (0) - VREF (N-1) to said two or more operational amplifiers, Two or more N-channel MOS transistors infixed between the output of two or more of said operational amplifiers, and the power

source, It has two or more P-channel MOS transistors between the output of two or more of said operational amplifiers, and ground potential. one electrical potential difference VREF (X) in the electrical potential difference VREF of the request for driving a liquid crystal panel (0) - VREF (N-1) -- this electrical potential difference VREF (X) -- an electrical potential difference only with the high threshold electrical potential difference Vthp of two or more of said P-channel MOS transistors -- or From VREF (X) of an electrical potential difference, to near [where only the threshold electrical potential difference Vthn of the N-channel MOS transistor is low] an electrical potential difference It is made to converge with supply voltage or ground potential in addition to the drive of two or more of said operational amplifiers. The liquid crystal display driving gear constituted after that so that the output voltage of two or more of said operational amplifiers might be completed as the desired electrical potential difference VREF (X) by the drive of a part for Vthp for a threshold electrical potential difference of said two or more P-channel MOS or the N-channel MOS transistor, or Vthn, and two or more of said operational amplifiers.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display driving gear which drives a liquid crystal panel.

[0002]

[Description of the Prior Art] Drawing 9 shows the conventional liquid crystal display driving gear. $R_0, R_1, \dots, R_M, R_{(M+1)}, \dots, R_N$ The resistance for carrying out resistance partial pressure of the potential difference between supply voltage V_{DD} and ground potential V_{SS} , and generating reference voltage, and $OP_0-OP_{(N-1)}$ The operational amplifier which carries out the buffer of the electrical potential difference V_{REF0} by which resistance partial pressure was carried out - the $V_{REF} (N-1)$, $SW_{00}-SW_0 (N-1)$, and ... $SW_{M0}-SW_M (N-1)$, and ... $SW_{(N-1)0}-SW_{(N-1)} (N-1)$ It is an output selection switch for outputting the output voltage of operational amplifiers $OP_0-OP_{(N-1)}$. An impedance is changed for an electrical potential difference $V_{REF0} - V_{REF} (N-1)$ with operational amplifiers $OP_0-OP_{(N-1)}$. A desired electrical potential difference (following, $V_{REF} (X)$) is outputted to a liquid crystal panel through Terminals $OUT_0-OUT_{(N-1)}$ from the output selection switches $SW_{00}-SW_0 (N-1)$ and the switch (following, SW_X) with which it is chosen of the $-SW(s) (N-1) (N-1)$.

[0003]

[Problem(s) to be Solved by the Invention] In order to use a liquid crystal panel for a pocket device or a personal digital assistant, in addition to a voltage output highly precise as a liquid crystal display driving gear, a high-speed drive and a low power are required.

[0004] When it changes from switches other than Switch SW_X to SW_X with this conventional configuration, it is difficult to drive only by the capacity of operational amplifiers $OP_0-OP_{(N-1)}$, and to fill both a low power and a high-speed drive.

[0005] Furthermore, since the configuration of a voltage follower is taken, if a high speed is made to drive, it will be easy to oscillate operational amplifiers

OP0-OP (N-1). This invention aims at offering a high-speed drive, a low power, and the stable liquid crystal display driving gear that is not oscillated.

[0006]

[Means for Solving the Problem] The liquid crystal display driving gear of this invention according to claim 1 Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers which supply an electrical potential difference to said two or more switches, and the resistance for giving reference voltage to said two or more operational amplifiers, Two or more comparators which act as the monitor of the output of two or more of said operational amplifiers, It has the output of two or more of said operational amplifiers, and two or more switches infixed between ground potential between the output of two or more of said operational amplifiers, and supply voltage. It is characterized by constituting so that said two or more comparators may change said two or more switches at the time of data modification and the output voltage to a liquid crystal panel may be completed as it.

[0007] At the time of the stationary which the output current over the convergence time amount at the time of data modification of this invention according to claim 2 is equipped with the capacity beyond the output current of two or more of said operational amplifiers, and does not still more specifically have data modification in claim 1 like, it is characterized by being a low power equivalent to a current at the time of the stationary of two or more of said operational amplifiers.

[0008] According to this configuration, it can accelerate without being dependent on the capacity of an operational amplifier, a high speed and the stability of not oscillating are filled to coincidence, and since the power consumption for improvement in the speed is only an inserted part of a comparator, it is further realizable by about several microampere.

[0009] The liquid crystal display driving gear of this invention according to claim 3 Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers supplied to said two or more switches, and the resistance for giving reference voltage to said two or more operational amplifiers, Have two or more comparators which act as the monitor of the output of two or more of said operational amplifiers, and the output voltage of two or more of said operational amplifiers is received. By increasing the bias of two or more of said operational amplifiers, and the capacity of the transistor which constitutes an output stage with said two or more comparators only at the time of data modification The capacity of two or more of said operational amplifiers is increased, and it is characterized by constituting so that the output voltage of two or more of said operational amplifiers may be completed.

[0010] Like, only when [of this invention / according to claim 4] there is data modification in claim 3, the capacity of said transistor which constitutes bias and an output stage is increased, the capacity of said transistor of bias and an output stage is reduced at the time of a steady state without data modification, and it is still more specifically characterized by constituting so that said two or more operational amplifiers may supply a low power and the stable electrical potential difference which is hard to oscillate.

[0011] According to this configuration, the capacity of an operational amplifier is changed, bias and the transistor capacity of an output stage are increased, by high-speed operation and the steady state, bias and the transistor capacity of an output stage can be reduced, and a low power and operational stability can be reconciled according to a transient.

[0012] The liquid crystal display driving gear of this invention according to claim 5 Two or more switches which are the liquid crystal display driving gears which supply the multiple-value electrical potential difference which generates two or

more electrical potential differences which drive a liquid crystal panel, and corresponded to the number of data lines of a liquid crystal panel, Two or more operational amplifiers OP0-OP (N-1) supplied to said two or more switches, The resistance for giving reference voltage VREF (0) - VREF (N-1) to said two or more operational amplifiers, Two or more N-channel MOS transistors infixed between the output of two or more of said operational amplifiers, and the power source, It has two or more P-channel MOS transistors between the output of two or more of said operational amplifiers, and ground potential. one electrical potential difference VREF (X) in the electrical potential difference VREF of the request for driving a liquid crystal panel (0) - VREF (N-1) -- this electrical potential difference VREF (X) -- an electrical potential difference only with the high threshold electrical potential difference Vthp of two or more of said P-channel MOS transistors -- or From VREF (X) of an electrical potential difference, to near [where only the threshold electrical potential difference Vthn of the N-channel MOS transistor is low] an electrical potential difference It is made to converge with supply voltage or ground potential in addition to the drive of two or more of said operational amplifiers. It is characterized by constituting so that the output voltage of two or more of said operational amplifiers may be completed as the desired electrical potential difference VREF (X) after that by the drive of a part for Vthp for a threshold electrical potential difference of said two or more P-channel MOS or the N-channel MOS transistor, or Vthn, and two or more of said operational amplifiers.

[0013] According to this configuration, at the time of a stationary without data modification, even if it is the same capacity as the former, since it is good, it becomes accelerable and it becomes possible of the drive of operational amplifiers OP0-OP (N-1) that it is good to the same extent [the potential difference (Vthp+alpha), or (Vthn+alpha) power consumption and the stability over an oscillation of operational amplifiers OP0-OP (N-1)] as the former.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of each operation of this

invention is explained based on drawing 1 R> 1 - drawing 8 . In addition, the liquid crystal display driving gear of the conventional example shown in drawing 9 can be written like drawing 10 , if it observes about an operational amplifier OPM. Here, V0 takes as electrical potential differences other than VREFM of VREF (0) - the VREF(s) (N-1), and SW0 is taken as switches other than the switch SWM of the switches SW0-SW (N-1).

[0015] (Gestalt 1 of operation) If drawing 1 shows the liquid crystal display driving gear of the (gestalt 1 of operation) of this invention and observes an operational amplifier OPM, it can be written like drawing 2 .

[0016] The conventional operational amplifiers OP0-OP (N-1) up and down Comparators COH0-COH (N-1), COL0-COL (N-1) are inserted. Comparators COH0-COH (N-1), Supply voltage VDD or ground potential VSS drives [the output of COL0-COL (N-1)] the output voltage of operational amplifiers OP0-OP (N-1) to near the electrical potential difference VREFX through Switches SWH0-SWH (N-1), and SWL0-SWL (N-1).

[0017] drawing 1 -- setting -- Rv0, Rpepsilon0, Rv1, and Rn -- epsilon0, ..., RvM, and RpepsilonM RnepsilonM Rv (M+1), ..., Rv (N-1), Rpepsilon (N-1), Rnepsilon (N-1), and RvN The resistance for carrying out resistance partial pressure of the potential difference between supply voltage VDD and ground potential VSS, and generating reference voltage, and OP0-OP (N-1) The electrical potential difference VREF0 by which resistance partial pressure was carried out, ..., VREFM, ..., the operational amplifier that carries out the buffer of the VREF (N-1), SW00-SW0 (N-1), and ... SWM0-SWM (N-1), and ... SW (N-1)0-SW (N-1) (N-1) It is an output selection switch for choosing the output voltage of operational amplifiers OP0-OP (N-1), and outputs to liquid crystal panel LCD from Terminals OUT0-OUT (N-1).

[0018] The comparator with which COH0 compares the output voltage and reference voltage VREF (0+alpha) of an operational amplifier OP0, The switch with which SWH0 was infixed between supply voltage VDD and the output of an operational amplifier OP0, The comparator with which COL0 compares the

output voltage and reference voltage V_{REF} ($0-\alpha$) of an operational amplifier OP_0 , SWL_0 is the switch infixed between ground potential V_{SS} and the output of an operational amplifier OP_0 , closing motion is changed with the output of a comparator COL_0 , and, as for a switch SWH_0 , closing motion is changed with the output of a comparator COH_0 , as for a switch SWL_0 .

[0019] The comparator with which $COHM$ compares the output voltage and reference voltage V_{REF} ($M+\alpha$) of an operational amplifier OPM about an operational amplifier OPM similarly hereafter, The switch with which $SWHM$ was infixed between supply voltage V_{DD} and the output of an operational amplifier OPM , The comparator with which $COLM$ compares the output voltage and reference voltage V_{REF} ($M-\alpha$) of an operational amplifier OPM , $SWLM$ is the switch infixed between ground potential V_{SS} and the output of an operational amplifier OP_0 , closing motion is changed with the output of Comparator $COLM$, and, as for Switch $SWHM$, closing motion is changed with the output of Comparator $COHM$, as for Switch $SWLM$.

[0020] The comparator with which COH ($N-1$) compares the output voltage and reference voltage V_{REF} ($N-1$) ($+\alpha$) of an operational amplifier OP ($N-1$) about an operational amplifier OP ($N-1$), The switch with which SWH ($N-1$) was infixed between supply voltage V_{DD} and the output of an operational amplifier OP ($N-1$), The comparator with which COL ($N-1$) compares the output voltage and reference voltage V_{REF} ($N-1$) ($-\alpha$) of an operational amplifier OP ($N-1$), SWL ($N-1$) is the switch infixed between ground potential V_{SS} and the output of an operational amplifier OP ($N-1$). Closing motion is changed with the output of Comparator COL ($N-1$), and, as for Switch SWH ($N-1$), closing motion is changed with the output of Comparator COH ($N-1$), as for Switch SWL ($N-1$).

[0021] As shown in drawing 2, $R1_1$, $R2_1$, $R_{\epsilon 1}$, and $R_{\epsilon 2}$ are resistance which generates reference voltage V_{REF} (M). The electrical potential difference V_{REF} ($M+\alpha$) pressured partially by resistance $R1_1$ and resistance $R_{\epsilon 1}-R2_1$ is inputted into the inversed input terminal ($-$) of Comparator COH . The electrical potential difference V_{REF} (M) pressured

partially by resistance $R1_1$ - $R_{\epsilon 1}$ and resistance $R_{\epsilon 2}$ - $R2_1$ is inputted into the non-inversed input terminal (+) of an operational amplifier OPM. The electrical potential difference V_{REF} (M- α) pressured partially by resistance $R1_1$ - $R_{\epsilon 2}$ and resistance $R2_1$ is inputted into the inversed input terminal (-) of Comparator COLM.

[0022] An operational amplifier OPM takes a voltage follower configuration, and the output M_{out} of an operational amplifier OPM supplies an electrical potential difference V_{REF} (M) to the non-inversed input terminal (+) of Comparator COHM, the non-inversed input terminal (+) of Comparator COLM, and Switch SWM.

[0023] Comparators COHM and COLM use supply voltage V_{DD} and ground potential V_{SS} for a high speed, and complete the output M_{out} of an operational amplifier OPM as it. SWM and SW0 are the switches for an output change of the output M_{out} of an operational amplifier OPM, and the output voltage V_0 of other operational amplifiers.

[0024] Thus, the actuation is explained about the constituted liquid crystal display driving gear. If the switch SW0 is chosen and Switch SWM is chosen from the condition that V_0 electrical potential difference is outputted to Terminal OUTM, the output voltage V_{REF} of an operational amplifier OPM (M) will be outputted.

[0025] In this case, from the case where potential rises to V_{REF} (M) and it converges from potential lower than V_{REF} (M), and potential higher than V_{REF} (M), potential may descend to V_{REF} (M) and the method of change of the electrical potential difference of the output M_{out} of an operational amplifier OPM may be converged.

[0026] First, the case where potential rises to V_{REF} (M) and it converges from potential with the output M_{out} of an operational amplifier OPM lower than V_{REF} (M) is explained. At this time, only an operational amplifier OPM operates and the initial state of the output M_{out} of an operational amplifier OPM completes the potential of an output M_{out} to V_{REF} (M), when potential is higher than V_{REF} (M- α). Since an electrical-potential-difference range is as small as a potential α volt at this time, even if it drives with the output M_{out} of an operational

amplifier OPM, high-speed operation is possible enough. α bolt is $V_{REF}(M+\alpha)-V_{REF}(M) = \alpha V_{REF}(M)-V_{REF}(M-\alpha) = \alpha V_{REF}(M)$. It is α .

[0027] However, when the output M_{out} of an operational amplifier OPM is smaller than $V_{REF}(M-\alpha)$, an electrical-potential-difference range is large. In this case, Comparator COLM makes Switch SWHM turn on to the potential near $V_{REF}(M-\alpha)$, and supply voltage V_{DD} is supplied until it becomes an electrical potential difference near $V_{REF}(M-\alpha)$ to an output M_{out} .

[0028] When the electrical potential difference of the output M_{out} of an operational amplifier OPM turns into an electrical potential difference near $V_{REF}(M-\alpha)$, Comparator COLM turns off Switch SWHM and the supply from supply voltage V_{DD} is cut. Then, with an operational amplifier OPM, it is made to go up to the $V_{REF}(M)$ potential from $V_{REF}(M-\alpha)$, and Terminal $OUTM$ is converged on an electrical potential difference $V_{REF}(M)$.

[0029] Thus, only when [big, Transient M_{out} , i.e. an output,] changing, in order to supply supply voltage V_{DD} with Comparator COLM, it becomes accelerable though it is the capacity of the operational amplifier OPM equivalent to the former.

[0030] Next, the case where potential descends to $V_{REF}(M)$ and it converges from potential with the output M_{out} of an operational amplifier OPM higher than $V_{REF}(M)$ is explained. At this time, only an operational amplifier OPM operates and the initial state of Terminal $OUTM$ completes the potential of Terminal $OUTM$ to $V_{REF}(M)$, when potential is lower than $V_{REF}(M+\alpha)$. At this time, even if an electrical-potential-difference range drives only with potential α and the small operational amplifier OPM, high-speed operation is fully possible.

[0031] However, when the output M_{out} of an operational amplifier OPM is larger than $V_{REF}(M+\alpha)$, an electrical-potential-difference range is large. In this case, it supplies until Comparator COHM makes Switch SWLM turn on and ground potential V_{SS} serves as an electrical potential difference near $V_{REF}(M-\alpha)$ to an output M_{out} to the potential near $V_{REF}(M-\alpha)$.

[0032] When the electrical potential difference of the output M_{out} of an operational amplifier OPM turns into an electrical potential difference near V_{REF}

(M+alpha), Comparator COHM makes Switch SWLM turn off and cuts the supply from ground potential VSS. Then, with an operational amplifier OPM, it is made to go up from VREF (M-alpha) to VREF (M), and the output Mout of an operational amplifier OPM is converged on an electrical potential difference VREF (M).

[0033] (Gestalt 2 of operation) Drawing 3 - drawing 6 show the liquid crystal display driving gear of the (gestalt 2 of operation) of this invention. Drawing 3 shows the liquid crystal display driving gear of the (gestalt 2 of operation) of this invention. Operational amplifiers OP0-OP (N-1) up and down Comparators COH0-COH (N-1), By inserting COL0-COL (N-1), and inputting the output of this comparator into operational amplifiers OP0-OP (N-1) It differs from the former in that the bias of operational amplifiers OP0-OP (N-1) and the transistor capacity of an output stage are changed in the time of a transient and a steady state.

[0034] drawing 3 -- setting -- Rv0, Rpepsilon0, Rv1, and Rn -- epsilon0, ..., RvM, and RpepsilonM RnepsilonM Rv (M+1), ..., Rv (N-1), Rpepsilon (N-1), Rnepsilon (N-1), and RvN The resistance for carrying out resistance partial pressure of the potential difference between supply voltage VDD and ground potential VSS, and generating reference voltage, and OP0-OP (N-1) The electrical potential difference VREF0 by which resistance partial pressure was carried out, ..., VREFM, ..., the operational amplifier that carries out the buffer of the VREF (N-1), SW00-SW0 (N-1), and ... SWM0-SWM (N-1), and ... SW (N-1)0-SW (N-1) (N-1) It is an output selection switch for choosing the output voltage of operational amplifiers OP0-OP (N-1), and outputs to liquid crystal panel LCD from Terminals OUT0-OUT (N-1).

[0035] The comparator with which COH0 compares the output voltage and reference voltage VREF (0+alpha) of an operational amplifier OP0, and COL0 are comparators which compare the output voltage and reference voltage VREF (0-alpha) of an operational amplifier OP0, and the capacity of an operational amplifier OP0 is controlled by the output of comparators COH0 and COL0. this (gestalt 2 of operation) -- the concrete configuration of an operational amplifier

OP0 is mentioned later.

[0036] Hereafter, similarly, about the operational amplifier OPM, the comparator with which COHM compares the output voltage and reference voltage VREF (M+alpha) of an operational amplifier OPM, and COLM are comparators which compare the output voltage and reference voltage VREF (M-alpha) of an operational amplifier OPM, and the capacity of an operational amplifier OPM is controlled by the output of Comparators COHM and COLM.

[0037] The comparator with which COH (N-1) compares the output voltage and reference voltage VREF (N-1) of an operational amplifier OP (N-1) about an operational amplifier OP (N-1), COL (N-1) is a comparator which compares the output voltage and reference voltage VREF (N-1) (-alpha) of an operational amplifier OP (N-1), and is controlling the capacity of an operational amplifier OP (N-1) by the output of Comparators COH (N-1) and COL (N-1).

[0038] If an operational amplifier OPM is observed, drawing 3 can be written like drawing 4 . As shown in drawing 4 , R1_2, R2_2, RpepsilonM, and RnepsilonM are resistance which generates reference voltage. The electrical potential difference VREF (M+alpha) pressured partially by resistance R1_2 and resistance RpepsilonM-R 2_2 is inputted into the reversal input (-) of Comparator COHM. The electrical potential difference VREF (M) pressured partially by resistance R1_2 - RpepsilonM, and resistance RnepsilonM-R 2_2 was inputted into the noninverting input (+) of an operational amplifier OPM, and it has inputted into resistance R1_2 - RnepsilonM, and the electrical potential difference VREF (M-alpha) pressured partially by resistance R2_2. COHM and COLM are the comparators for changing capacity to a slow mode, after converging on fast mode, in order to complete the operational amplifier output Mout as a high speed.

[0039] The operational amplifier OPM is constituted as shown in drawing 5 . The operational amplifier OPM consists of the differential amplifier section which consists of P-channel MOS transistors MP1, MP2, MP5, and MP6 and N-channel MOS transistors MN1, MN2, MN5, and MN6, a control circuit 100, and P-channel MOS transistor MP3, and MP4 and the output stage which consists of N-channel

MOS transistors MN3 and MN4. A control circuit 100 constitutes AB class circuit of an operational amplifier, and this circuit determines transistor MP3, the consumed electric current of MN3, and current capacity.

[0040] Thus, the actuation is explained about the constituted liquid crystal display driving gear. If the switch SW0 is chosen and Switch SWM is chosen as the output Mout of an operational amplifier OPM from the condition that the electrical potential difference V0 is outputted, the output voltage VREF of an operational amplifier OPM (M) will be outputted.

[0041] In this case, from potential higher than the case where potential rises to VREF (M) and it converges from potential lower than VREF (M), and VREF (M), potential may descend to VREF (M) and the method of change of the electrical potential difference of the output Mout of an operational amplifier OPM may be converged.

[0042] First, the case where potential rises to VREF (M) and it converges from potential with the output Mout of an operational amplifier OPM lower than VREF (M) is explained. At this time, only an operational amplifier OPM operates and the initial state of the output Mout of an operational amplifier OPM completes the potential of the output Mout of an operational amplifier OPM to VREF (M), when potential is higher than VREF (M-alpha). Since an electrical-potential-difference range is as small as alpha at this time, even if it drives only with an operational amplifier OPM, high-speed operation is possible enough.

[0043] Moreover, at this time, to an operational amplifier OPM, the signal of "L" level is outputted as a control signal, consequently the switches SWH1 and SWH2 of drawing 5 are connected with supply voltage VDD, SWL1 and SWL2 of drawing 5 are connected with ground potential VSS, and bias of the bias of the input side of an operational amplifier OPM is carried out for Comparator COLH through transistors MP1 and MN1. Since bias of the output side of an operational amplifier OPM is carried out through transistor MP3 and MN3 and transistors MP2, MP4, MN2, and MN4 do not operate, an operational amplifier OPM is a low power, and has the high stability over an oscillation.

[0044] However, when the output M_{out} of an operational amplifier OPM is smaller than $V_{REF} (M-\alpha)$, an electrical-potential-difference range is large. In this case, Comparator COHM takes out the signal of "H" level as a control signal to the potential near $V_{REF} (M-\alpha)$. In order for SWH1, SWH2, SWL1, and SWL2 which were added to the interior of an operational amplifier OPM to change and to make transistors MP2, MP4, MN2, and MN4 into an ON state by this, the bias of an operational amplifier OPM and the capacity of an output stage are improved, consequently the frequency characteristics of an operational amplifier OPM and output drive capacity are improved.

[0045] Soon, if the potential of the output M_{out} of an operational amplifier OPM rises to near $V_{REF} (M-\alpha)$, Comparator COHM will output the signal of "L" level as a control signal, and the OFF state of the transistors MP2, MP4, MN2, and MN4 of an operational amplifier OPM will be carried out. The bias of an operational amplifier OPM and the transistor of an output stage will be in the condition of being return and a low power and having the high stability over an oscillation in the condition that a transistor is not added, by this.

[0046] Next, the case where potential descends to $V_{REF} (M)$ and it converges from potential with the output M_{out} of an operational amplifier OPM higher than $V_{REF} (M)$ is explained. At this time, only an operational amplifier OPM operates and the initial state of the output M_{out} of an operational amplifier OPM completes the potential of the output M_{out} of an operational amplifier OPM to $V_{REF} (M)$, when potential is higher than $V_{REF} (M+\alpha)$. Since an electrical-potential-difference range is as small as α at this time, even if the output M_{out} of the previous operational amplifier OPM rises and it drives only with an operational amplifier OPM like a case, high-speed operation is possible, and it is a low power, and has the high stability over an oscillation.

[0047] However, when the output M_{out} of an operational amplifier OPM is larger than $V_{REF} (M+\alpha)$, an electrical-potential-difference range is large. In this case, to the potential near $V_{REF} (M+\alpha)$, Comparator COLM outputs the signal of "H" level as a control signal, SWH1, SWH2, SWL1, and SWL2 which

were added to the interior of an operational amplifier OPM change, and transistors MP2, MP4, MN2, and MN4 are turned on. The bias of an operational amplifier OPM and the capacity of an output stage are improved by this, consequently the frequency characteristics of an operational amplifier OPM and output drive capacity are gone up.

[0048] Soon, if the potential of the output Mout of an operational amplifier OPM descends to near $V_{REF} (M+\alpha)$, Comparator COLM outputs the signal of "L" level as a control signal, SWH1, SWH2, SWL1, and SWL2 which were added to the interior of an operational amplifier OPM will change, and transistors MP2, MP4, MN2, and MN4 will be in an OFF state. The bias of an operational amplifier OPM and the transistor of an output stage will be in the condition of being return and a low power and having the high stability over an oscillation in the condition that a transistor is not added, by this.

[0049] Therefore, in the condition that data are not changed, though it is the high stability and power consumption to an oscillation, a liquid crystal display driving gear can be accelerated, when data are changed.

[0050] Actuation is explained in more detail. When the potential of the output Mout of an operational amplifier OPM is lower than an electrical potential difference $V_{REF} (M-\alpha)$, Comparator COLM outputs the signal of "H" level as a control signal, and Comparator COHM outputs the signal of "L" level as a control signal. It operates, as the switches SWH1, SWH2, SWL1, and SWL2 of the operational amplifier OPM shown in drawing 5 show by this drawing 6 .

[0051] By actuation of switches SWH1 and SWL1, Bias P and Bias N are impressed also to the gate of transistors MP2 and MN2, and the frequency characteristics of this condition of an operational amplifier OPM improve. Furthermore, with a switch SWH2, an input signal is impressed also to the gate of a transistor MP 4, and output current capacity improves.

[0052] By this, the high-speed operation of the output Mout of an operational amplifier OPM becomes possible from potential lower than $V_{REF} (M-\alpha)$ to $V_{REF} (M+\alpha)$. Next, when the potential of the output Mout of an operational

amplifier OPM is between electrical potential differences $V_{REF} (M-\alpha)$ and $V_{REF} (M+\alpha)$, Comparator COLM outputs the signal of "L" level as a control signal, and Comparator COHM outputs the signal of "L" level as a control signal. It operates, as this shows drawing 6 .

[0053] Since the potential difference with the reference voltage of the output M_{out} of an operational amplifier OPM is less than 2α , the capacity of an operational amplifier OPM is made to lower and low-power-ize in this condition. At this time, the differential bias circuit of drawing 5 consists of transistors MP1 and MN1, transistor MP3 for an output, and MN4, and both the frequency characteristics of an operational amplifier OPM and its current capacity are small. However, since transistors MP1 and MN1 and the transistor for an output can be constituted for a differential amplifier bias circuit from MP3 and MN4, low-power-ization is attained.

[0054] Moreover, when the potential of the output M_{out} of an operational amplifier OPM is lower than an electrical potential difference $V_{REF} (M-\alpha)$, Comparator COLM outputs the signal of "L" level as a control signal, and Comparator COHM outputs the signal of "H" level as a control signal. It operates, as the switches SWH1, SWH2, and SWL2 of the operational amplifier OPM which this showed to drawing 5 show drawing 6 . Furthermore, with a switch SWL2, the transistor for an output serves as transistor MP3 and MP4, and output current capacity improves.

[0055] By actuation of switches SWH1 and SWL1, Bias P and Bias N are impressed also to the gate of transistors MP2 and MN2, and the frequency characteristics of this condition of an operational amplifier OPM improve. By this, the high-speed operation of the output M_{out} of an operational amplifier OPM becomes possible from potential higher than $V_{REF} (M+\alpha)$ to $V_{REF} (M+\alpha)$.

[0056] (Gestalt 3 of operation) Drawing 7 and drawing 8 show the liquid crystal display driving gear of the (gestalt 3 of operation) of this invention. drawing 7 -- setting -- R_{v0} , $R_{\epsilon 0}$, R_{v1} , and R_n -- ϵ_0 , ..., R_{vM} , and $R_{\epsilon M}$

$R_{\epsilon M}$, $R_v (M+1)$, ..., $R_v (N-1)$, $R_{\epsilon (N-1)}$, $R_{\epsilon (N-1)}$, and R_{vN}
 The resistance for carrying out resistance partial pressure of the potential difference between supply voltage VDD and ground potential VSS, and generating reference voltage, and OP0-OP (N-1) The electrical potential difference VREF0 by which resistance partial pressure was carried out, ..., VREFM, ..., the operational amplifier that carries out the buffer of the VREF (N-1), SW00-SW0 (N-1), and ... SWM0-SWM (N-1), and ... SW (N-1)0-SW (N-1) (N-1) It is an output selection switch for choosing the output voltage of operational amplifiers OP0-OP (N-1), and outputs to liquid crystal panel LCD from Terminals OUT0-OUT (N-1).

[0057] As for MNH0, the output circuit of a transistor MNH0 is infixed between the output of the operational amplifier OP0 with which the N-channel MOS transistor with which reference voltage VREF (0+alpha) was impressed to the gate, and MPL0 are the P-channel MOS transistors with which reference voltage VREF (0-alpha) was impressed to the gate, and buffer connection was made, and supply voltage VDD. The output circuit of a transistor MPL0 is infixed between the output of an operational amplifier OP0, and ground potential VSS.

[0058] Hereafter, similarly, about the operational amplifier OPM, the N-channel MOS transistor with which, as for MNHM, reference voltage VREF (M+alpha) was impressed to the gate, and MPLM are the P-channel MOS transistors with which reference voltage VREF (M-alpha) was impressed to the gate, and the output circuit of Transistor MNHM is infixed between the outputs of an operational amplifier OPM and supply voltage VDD by which buffer connection was made. The output circuit of Transistor MPLM is infixed between the output of an operational amplifier OPM, and ground potential VSS.

[0059] The N-channel MOS transistor with which, as for MNH (N-1), reference voltage VREF (N-1) (+alpha) was impressed to the gate about the operational amplifier OP (N-1), MPL (N-1) is the P-channel MOS transistor with which reference voltage VREF (N-1) (-alpha) was impressed to the gate, and the output circuit of Transistor MNH (N-1) is infixed between the outputs of an operational

amplifier OP (N-1) and supply voltage VDD by which buffer connection was made. The output circuit of Transistor MPL (N-1) is infixed between the output of an operational amplifier OP (N-1), and ground potential VSS.

[0060] In drawing 7 , if an operational amplifier OPM is observed, it can write like drawing 8 . As shown in drawing 8 , it is the resistance which generates reference voltage, and resistance R1_3, R2_3, RpepsilonM, and RnepsilonM connect with resistance R1_3 the electrical potential difference VREF (M+alpha) pressured partially by resistance RpepsilonM-R 2_3 at the gate of Transistor MNHM, and the drain of Transistor MNHM is connected to supply voltage VDD, and they connect the source to the output Mout of an operational amplifier OPM. Furthermore, the electrical potential difference VREF (M-alpha) pressured partially by resistance R2_3 is connected with resistance R1_3 - RnepsilonM at the gate of Transistor MPLM, the drain of Transistor MPLM is connected to ground potential VSS, and the source is connected to the output Mout of an operational amplifier OPM. Moreover, the electrical potential difference VREF (M) pressured partially by R1_3 - RnepsilonM, and RpepsilonM-R 2_3 is impressed to the noninverting input (+) of an operational amplifier OPM, and an operational amplifier OPM is outputted through Switch SWM as a configuration of a voltage follower. Moreover, when Switch SWM is not chosen, the output voltage V0 of other operational amplifiers is outputted through a switch SW0.

[0061] Thus, about the constituted liquid crystal display, the actuation is explained below. If the switch SW0 is chosen and Switch SWM is chosen from the condition that electrical potential differences other than VREF (M) are outputted, VREF (M) will be outputted to the output voltage of an operational amplifier OPM.

[0062] In this case, the method of electrical-potential-difference change of the output Mout of an operational amplifier OPM may descend from an electrical potential difference lower than the case where it goes up from an electrical potential difference lower than VREF (M) to VREF (M), and VREF (M), and may be converged.

[0063] First, the case where potential rises to $V_{REF}(M)$ and it converges from potential with the output M_{out} of an operational amplifier OPM lower than $V_{REF}(M)$ is explained. Since an electrical-potential-difference range is small, it can make $V_{REF}(M)$ converge only operational amplifier OPM on a high speed with $(\alpha - V_{thp})$, when setting the threshold electrical potential difference of Transistor MNHM to V_{thp} at this time, and Terminal OUTM is larger than $(V_{REF}(M + \alpha) - V_{thp})$.

[0064] However, when smaller than $(V_{REF}(M + \alpha) - V_{thp})$, an electrical-potential-difference range is large. In this case, to $(V_{REF}(M + \alpha) - V_{thp})$, Transistor MNHM turns on and supply voltage V_{DD} is supplied till supplying the output M_{out} of an operational amplifier OPM $(V_{REF}(M + \alpha) - V_{thp})$. When the output M_{out} of an operational amplifier OPM comes to $(V_{REF}(M + \alpha) - V_{thp})$, Transistor MNHM turns off, you cut off supply from supply voltage V_{DD} , and an operational amplifier OPM makes it converge from $(V_{REF}(M + \alpha) - V_{thp})$ to $V_{REF}(M)$.

[0065] Next, the case where potential descends to $V_{REF}(M)$ and it converges from potential with the output M_{out} of an operational amplifier OPM higher than $V_{REF}(M)$ is explained. Since an electrical-potential-difference range is small, it can make $V_{REF}(M)$ converge only operational amplifier OPM on a high speed with $(-\alpha + V_{thn})$, when considering as the threshold electrical potential difference V_{thn} of Transistor MPLM at this time, and the output M_{out} of an operational amplifier OPM is smaller than $(V_{REF}(M - \alpha) + V_{thn})$.

[0066] However, when larger than $(V_{REF}(M - \alpha) + V_{thn})$, an electrical-potential-difference range is large. In this case, to $(V_{REF}(M - \alpha) + V_{thn})$, Transistor MPLM turns on and ground potential V_{SS} is supplied till supplying the output M_{out} of an operational amplifier OPM $(V_{REF}(M - \alpha) + V_{thn})$. When the output M_{out} of an operational amplifier OPM comes to $(V_{REF}(M - \alpha) + V_{thn})$, Transistor MPLM turns off, you cut off supply from ground potential V_{SS} , and an operational amplifier OPM makes it converge from $(V_{REF}(M - \alpha) + V_{thn})$ to $V_{REF}(M)$.

[0067]

[Effect of the Invention] Since a comparator and the added transistor do not operate as mentioned above in the condition that data do not change by having newly added the transistor between a comparator, and a power source and an operational amplifier to the system according to this invention Though it is stability equivalent to the former, and power consumption, in the condition that data change Output voltage supplies [this comparator] a high speed from supply voltage VDD or ground potential VSS to near VREF through a switch. the added transistor -- from $(VREF + V_{thp} + \alpha)$ supply voltage VDD or ground potential VSS $(VREF - V_{thn} - \alpha)$ -- up to -- by supplying, it becomes possible to accelerate without making it dependent on the capacity of an operational amplifier.

[Translation done.]

* NOTICES *

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The block diagram of the liquid crystal display driving gear in the (gestalt 1 of operation) of this invention

[Drawing 2] The explanatory view of the gestalt of this operation

[Drawing 3] The block diagram of the liquid crystal display driving gear in the (gestalt 2 of operation) of this invention

[Drawing 4] The explanatory view of the gestalt of this operation

[Drawing 5] The circuit diagram of the operational amplifier of the gestalt of this operation

[Drawing 6] The related Fig. of each output state of the comparator of the gestalt of this operation, and the change condition of each switch

[Drawing 7] The block diagram of the liquid crystal display driving gear in the (gestalt 3 of operation) of this invention

[Drawing 8] The explanatory view of the gestalt of this operation

[Drawing 9] The block diagram of the conventional liquid crystal display driving gear

[Drawing 10] The explanatory view of the example of *****

[Description of Notations]

VDD Supply voltage

VSS Ground potential

out (N-1) from out0, OUTM Output terminal of a liquid crystal display driving gear

VREF (0) - VREF (N) Nth electrical potential difference of the electrical potential difference which pressured VDD and VSS partially by R0-RN

VREF (M) Electrical potential difference which pressured VDD and VSS partially by Resistance R0-RM and Resistance R (M-1) and RN

V0 One electrical potential difference in in VREF (0) to VREF(s) (N-1) other than VREF (M)

VREF (M+alpha) VREF (M) -- alpha (> 0) -- high electrical potential difference

VREF (M-alpha) VREF (M) -- alpha (> 0) -- low electrical potential difference

OP0- OP (N-1) and OPM Operational amplifier

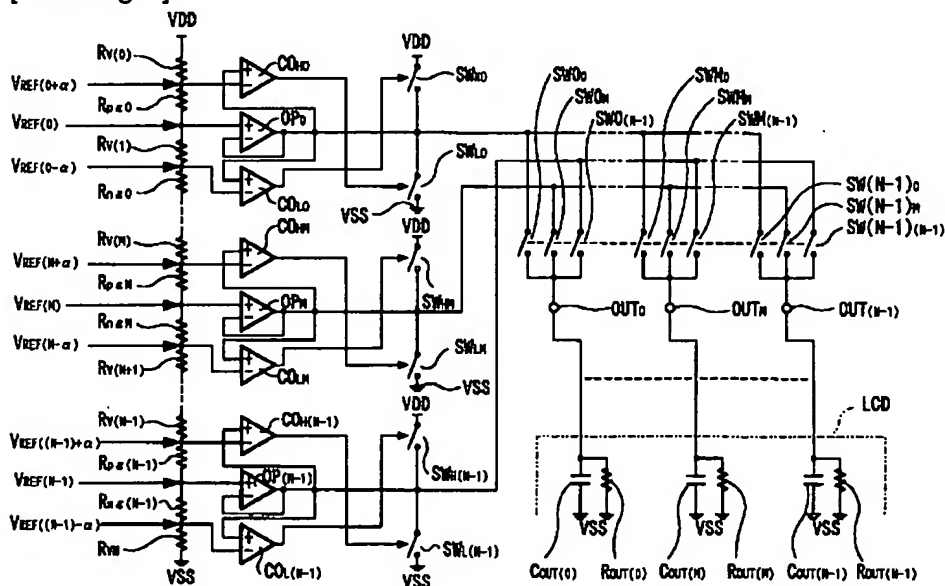
SW00-SW (N-1) (N-1) Switch

SWHM, SWLM Switch

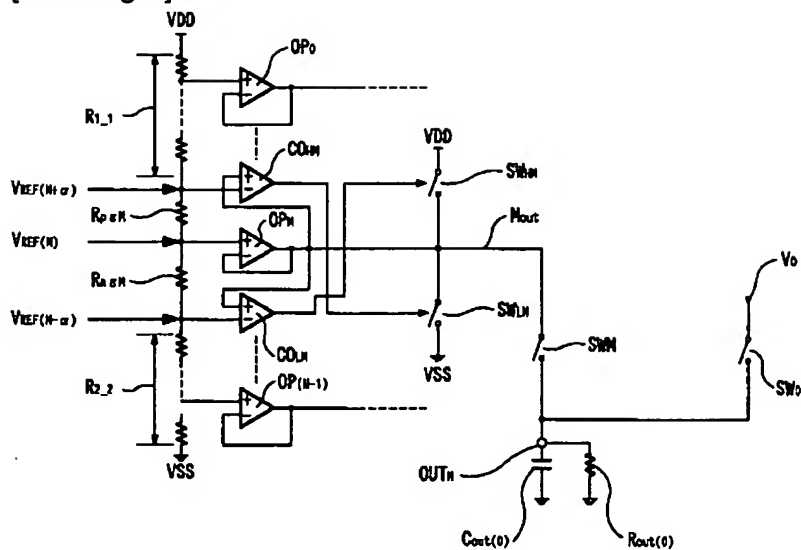
COHM, COLM Comparator

SWH1, SWH2 Switch

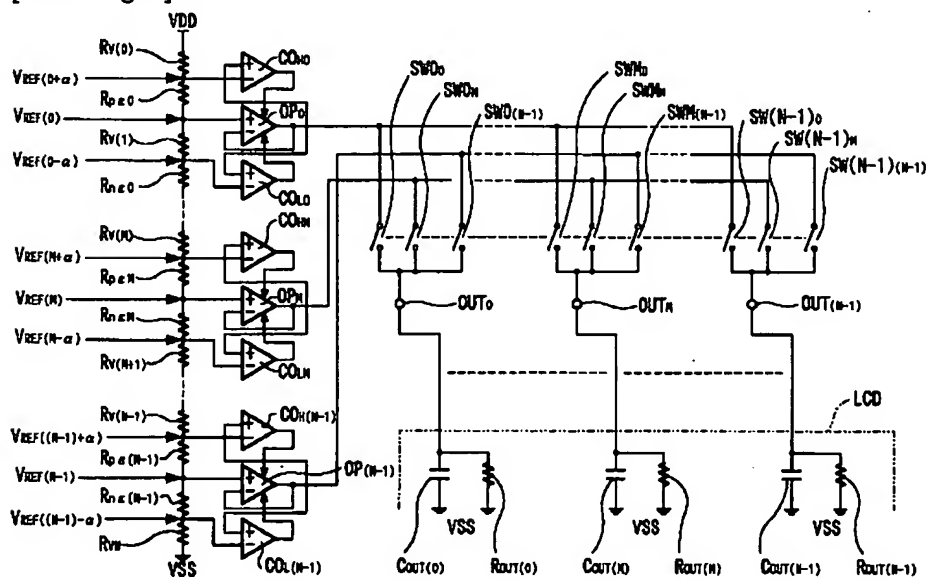
MNH0-MNH (N-1) N-channel MOS transistor



[Drawing 2]



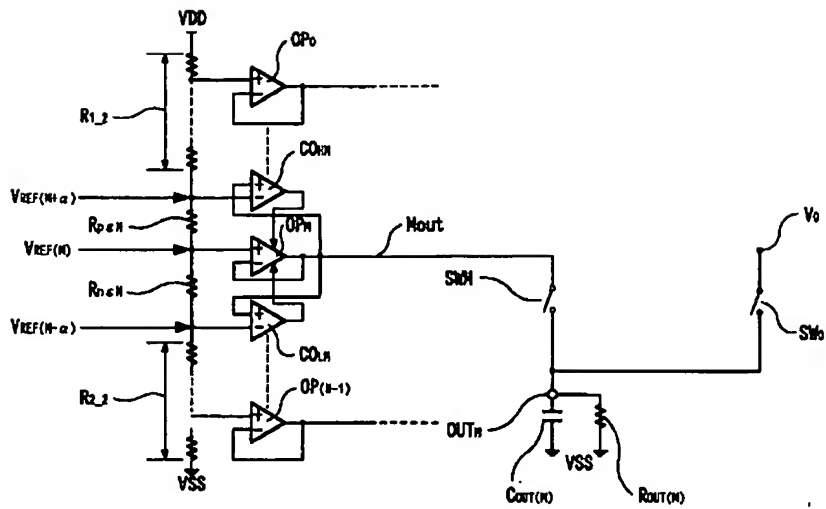
[Drawing 3]



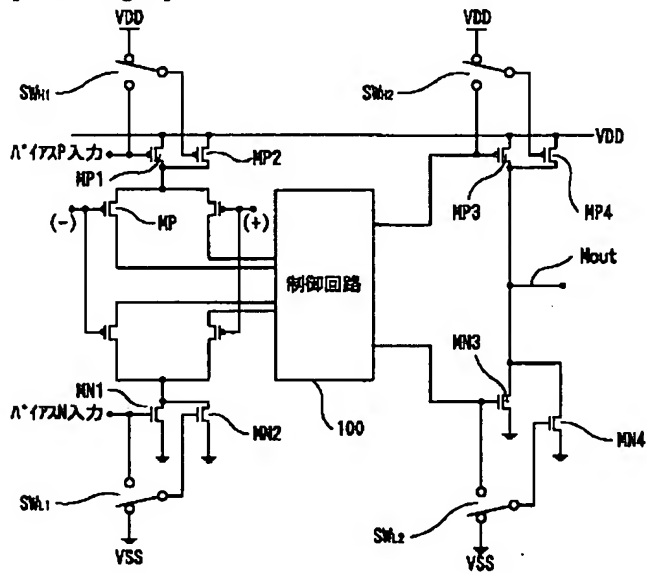
[Drawing 6]

COH	COH	S1b1	S1b2	S1b1	S1b2	お*ア/ア*OPの消費電流	お*ア/ア*OPの出力
L	L	VDD	VDD	VSS	VSS	小	小
L	H	A*472P	MP3*ト電圧	A*472H	VSS	大	大
H	L	A*472P	VDD	A*472H	MP3*ト電圧	大	大
H	H	-	-	-	-	-	-

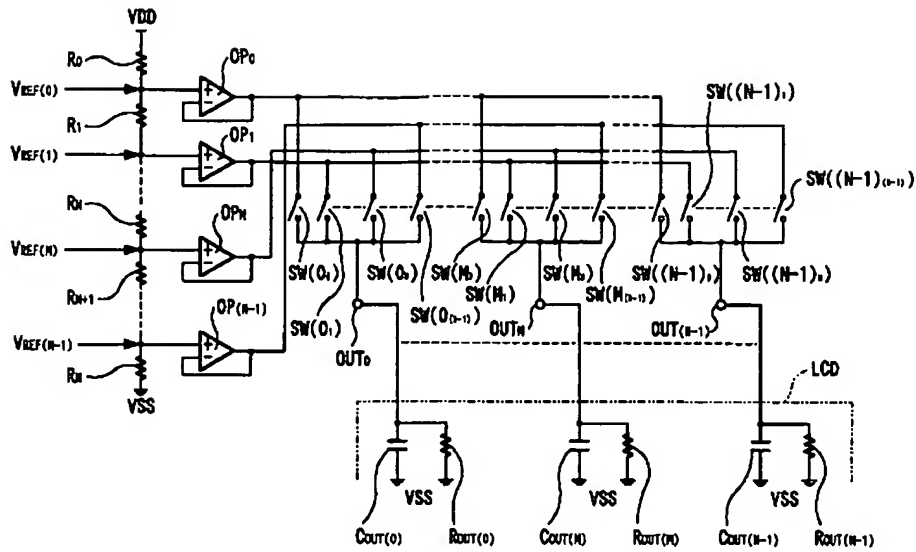
[Drawing 4]



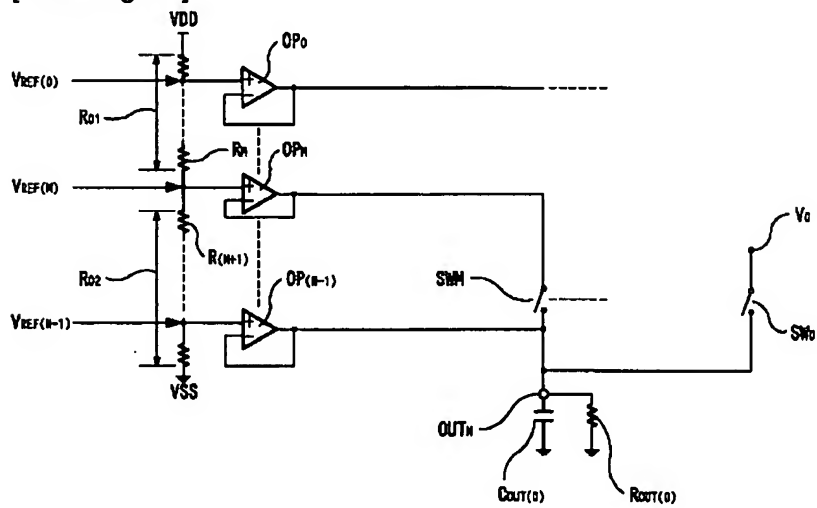
[Drawing 5]



[Drawing 8]



[Drawing 10]



[Translation done.]